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TECHNOLOGY TRANSFER AND CHALLENGES FACING SMALL BUSINESS

HEARING

BEFORE THE

COMMITTEE ON SMALL BUSINESS
UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

TECHNOLOGY TRANSFER AND CHALLENGES FACING SMALL BUSINESS

MARCH 8, 1990

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March 8, 1990:
Morning session 1

TECHNOLOGY TRANSFER AND CHALLENGES FACING SMALL BUSINESS

THURSDAY, MARCH 8, 1990

U.S. SENATE,
COMMITTEE ON SMALL BUSINESS,
Washington, DC.

The Committee met, pursuant to notice, at 9:34 a.m., in room SR-428A, Russell Senate Office Building (Hon. Rudy Boschwitz) presiding.

STATEMENT OF HON. CHARLES E. GRASSLEY, A U.S. SENATOR FROM THE STATE OF IOWA

Senator GRASSLEY [presiding]. I am Senator Grassley from Iowa, while I am a Member of this Committee, I am not either the Ranking Republican, and obviously I am not the Democratic Chairman of the Committee. But the staff of the Committee has suggested that it would be appropriate for me to start this meeting. I welcome the witnesses who have to work so hard for preparation of testimony for this hearing and, more importantly, people from the Washington world as well as outside of Washington who are involved in the subject matter of the hearing.

I want to thank the Chairman and the Ranking Republican for holding this hearing on an important issue of Technology Transfer to our Nation's small businesses.

It has been estimated that research and development expenditures for the Federal Government for fiscal year 1989 will approximate $62 billion and for fiscal year 1990 budget outlays propose, $71 billion.

The results of these Federal R&D efforts will not be commercialized by the Federal Government. This task has been left to our Nation's businesses. So the transfer of the technology generated by the Federal Government to the business community is recognized as playing an important role in stimulating economic growth.

Small businesses which have a vital role in our Nation's economy are at a disadvantage when it comes to fully utilizing the various Federal programs which have been created to assist in Technology Transfer.

Small businesses simply lack the time and money to wade through the Federal quagmire to participate in Technology Transfer Programs. This disadvantage translates into a loss for small business and also for the economy.

Referring to my own State of Iowa, we are particularly interested in the issue of Technology Transfer. In 1987 the Center for Ad-

vanced Technology and Development was established at Iowa State University, a land grant institution in Ames, IO.

Through the efforts of the Federal Government, industry, and ISU scientists and administrators, the center conducts applied research, facilitates Technology Transfer, and assists in creating business opportunities.

I believe the center is an effective tool in the Government's Technology Transfer Program. Congress has attempted to promote a Technology Transfer process legislatively in hopes of assisting the private sector in obtaining this very valuable information.

Now, it is our goal today to review the effectiveness of these efforts and to determine what more needs to be done in this area. So I look forward to hearing the insights and recommendations of our witnesses, and I want to thank each of you for appearing before the Committee.

It is my pleasure to welcome a person that I have had an opportunity to work with on a few issues in the House of Representatives, particularly health care, the Honorable Ron Wyden of the Subcommittee on Regulation. He is the Chairman of the Subcommittee on Regulation, Business Opportunities and Energy. Another person with whom I have had a great deal of conversation over a couple of other committees in the last 2 weeks, Dr. D. Allan Bromley, Director of the White House Office of Science and Technology.

So, Congressman Wyden, please begin.

STATEMENT OF HON. RON WYDEN, A. U.S. REPRESENTATIVE FROM THE STATE OF OREGON

Congressman WYDEN. Thank you very much, Senator, and with the Chair's permission perhaps I could put my prepared remarks into your formal record. I will not filibuster here this morning, maybe just to make a few comments and then I am anxious to have your questions.

Senator GRASSLEY. Please. Everybody's statement in total will be printed in the record, and we do encourage summarization.

Congressman WYDEN. And I also want to thank the fine staff of the Subcommittee. Our staff had developed a memo last fall when we held our hearings on Technology Transfer, and I know your folks have made that available, and we are very appreciative of all the courtesies extended to us.

Mr. Chairman and colleagues, I think what is at stake here is really the opportunity for the United States to tap what I think is a technological treasure trove. The Federal Government is spending about $60 billion a year on research, and according to the last account of the General Accounting Office, which are figures that we have from 1988, the license revenue returning to the Federal Government is less than $4 million. So that is a return on investment of .00005 percent.

We are getting very little back at this point in terms of the enormous investment made by taxpayers at these Federal laboratories. In fact, what the General Accounting Office found was that most of that $4 million return that is in license revenue came through just one invention, an AIDS test kit developed at the National Institutes of Health, one agency that is working very hard at Transfer.

The National Institutes of Health spent something like $9 billion a year on scientific research. The technologies there have failed to be transferred to the private sector because the Agency apparently does not have enough lawyers to promptly and properly prosecute its patents.

So, I am of the view that we have an enormous gap in terms of transferring these innovations from the Federal Government to the private sector, and I would suggest, Mr. Chairman, that this is probably the area where we can do much to help stimulate America's ability to compete in world markets without spending one additional penny of the taxpayers' money.

Not only do we not need to spend any more of the taxpayers' money, but there is no evidence that we need a lot more legislation on the books.

We have got a number of very important and very good laws on the books. The problem has been that they have been honored more in the breach than in the observance.

I think what this is, Mr. Chairman, is essentially a question of political will in terms of the Administration. At this point a number of key Technology Transfer positions are vacant. The most important opening may be the Under Secretary of Commerce for Technology where there still is not a confirmed tenant.

This is a particularly important job. This position has been officially vacant for more than 14 months. There is a tentative selection that has been proposed for confirmation. But as of now this job has been open for 14 months, and this is the key position.

I think we need an explicit and definitive pronouncement from the President that Technology Transfer is a priority for the Federal lab system. I am convinced if the boss says it is important, the individual lab directors are going to take heed.

We have been surveying the individual lab directors. We have got one or two of the major labs still out, but as soon as those findings come in, we will submit them to you.

When Dr. Bromley testified before my Committee in October we asked for a specific game plan to be furnished our Subcommittee early this year, specifically in February. We still do not have that yet, and I hope that the Administration will produce a definitive game plan soon.

Finally, Mr. Chairman, I think if the numbers do not get any better, I think we ought to start examining the prospect of a profit-making technology brokerage system along the lines of the British model.

They have a quasi-independent agency, the British Technology Group, that has served as a technology brokerage for more than 4 decades. It sells technology from British labs. It buys technology on the international market for British companies. And it is now making a significant profit on its activities.

There are a number of other ideas that I outlined in my testimony. One that has substantial support among the small business community is the concept of establishing a national database in cooperation with the States that would tell business persons what is going on in these labs. That way we have a chance to match needs with technological solutions, and one comment that I believe you will hear from your business witnesses is again and again and

again they have these needs and they simply cannot find out from the various labs what technologies are available.

And in the staff memo that has been made available to the Members, we have outlined some of the specific horror stories where small businesses have essentially been trying to wend their way through these federally funded labs for months and simply could not get the innovations out of the system.

So I very much appreciate the chance to come. The memo that we did I think outlines in further some of the specific problems.

One other problem we found is that very often the labs bucked the decision to Washington, DC, buck it to the centralized authority, and it seems to wait there. There has been a disinterest by some labs in commercialization as a priority, but I think that ultimately this is going to be a question of political will. It is going to be a question of the Congress and the Administration working together to say that this is an area where, without spending any more money, without passing any new laws, we can make a significant difference in stimulating our economy and in promoting our ability to compete in very tough markets.

[The prepared statement of Congressman Wyden follows:]

Third District, Oregon

News from
Congressman Ron Wyden

2452 Rayburn House Office Building Washington, D.C. 20515 (202) 225-4811

HEARING STATEMENT
TECH TRANSFER OBSTACLES AT FEDERAL LABORATORIES

REP. RON WYDEN, D-ORE.
MARCH 8, 1990

BEFORE THE
SENATE SMALL BUSINESS COMMITTEE

Mr. Chairman, good morning. I'm pleased to speak on a critical national economic issue that concerns us both -- the crippling roadblocks facing our small businesses when they go after commercial technologies in our federal laboratories.

I'm honored to be here with my old friend from West Virginia, Senator Rockefeller, and my new friend from the White House Science and Technology Policy Office, Dr. Bromley.

Dr. Bromley spoke about federal technology transfer before my House Small Business Subcommittee last October. He was frank and candid in describing the variety of problems in federal labs. I believe he sincerely wants to find remedies. And I want to work with him.

Today we examine a fundamental barrier for U.S. businesses striving to compete in global markets. This deal-stopper is the web of obstacles faced by small businesses attempting to identify, acquire and use industrial technologies developed within our network of 700 federal laboratories.

These facilities are making breakthroughs in new drugs, superconducting materials, lasers and thousands of other fields. They are the backbone of the nation's research and development effort. Fifty cents of every dollar invested in basic and applied research in this country is spent in a federally supported laboratory.

And the cost to taxpayers last year was more than $60 billion. That heady investment creates a treasure trove of knowledge. But the vast majority remains on the shelf, waiting for commercial application.

These scientific breakthroughs can help create new products and businesses, and new American manufacturing jobs. They can provide the vital technologies we need to survive as an international industrial power.

But according to testimony last year at hearings held by my House Small Business Subcommittee on Regulation, Business Opportunities and Energy, only a trickle of that river of federal lab knowledge is ever commercialized. Let me give you just one indication of the proportions of that problem:

According to the U.S. General Accounting Office, patent license revenue returning to the federal government in 1988 from the customers of federal labs totalled less than $4 million.

That's a return on investment of .00005 percent. And most of that $4 million came from a single invention -- an AIDS test kit technology developed by the National Institutes of Health.

Perhaps no agency is working harder at transfer than the National Institutes of Health, which spends something on the order of $9 billion per year on scientific research. But even here we have problems. Technologies have failed to be transferred to the private sector because the agency apparently doesn't have enough lawyers to promptly and properly prosecute its patents. We're talking about technologies and techniques that could help folks lead longer and better lives. It's tragic.

Mr. Chairman, certainly we want to see the taxpayer get a fair return from our federal laboratory investment. It bothers me that these license revenues are so low. But more than that, I am greatly dismayed that so little of this knowledge apparently reaches the folks who are developing new businesses and creating new jobs.

I'd like to introduce into the record a subcommittee staff memorandum prepared after nearly a year's research into this problem. Among its findings, the memo indicates that some of our principal economic rivals -- the Japanese and the Germans -- do a far better job in converting laboratory knowledge into new products and industrial processes.

This transfer gap is tragic. It ought to concern every American and especially those of us in Congress who must exercise oversight on these labs.

Mr. Chairman, we have good laws on the books encouraging federal technology transfer. The Federal Technology Transfer Act of 1986 set out practical rules and regulations in this area, including incentives for labs and scientists. Executive Order 12591 of 1987 delegated deal-closing authority to individual labs. But the tech transfer record, so far, has been pretty thin.

Indeed, some agencies and labs seem to be ignoring technology transfer altogether.

Now, I'm going to say something pretty astonishing for a congressman. I don't think we need to pass any new laws. The current statutes are good enough to do the job. What seems to be missing is the executive willpower to enforce those rules -- to ensure that technology transfer is a top priority at every federal laboratory.

I'd like to encourage the following:

1. We can begin by filling vacant technology transfer policy and enforcement positions throughout government. The most important opening may be the Undersecretary of Commerce for Technology, which does not yet have a confirmed tenant. This is a particularly important job. The position has been officially vacant for more than 14 months. I understand that a tentative selection has been proposed for confirmation, and I would hope that happens soon.

2. I'd also hope that Dr. Bromley be given the political clout he needs to encourage better transfer efforts throughout the federal system. We need a hammer within the Administration, and Dr. Bromley's well-positioned for that role.

3. But ultimately, I think we need an explicit and definitive pronouncement by the President that technology transfer is a priority for the federal lab system. I'm convinced that if the boss says it's important, individual lab directors will take heed.

4. I think we need to take a hard look at creating a national database, in cooperation with the states, that will tell businesspersons what's going on in these labs, and help match real needs with real technological solutions.

5. Finally, if the numbers don't get any better, I'd encourage experimentation with profit-making technology brokerage systems on the British model. My staff notes that the British Technology Group -- a quasi-independent agency -- has served as a technology brokerage for more than four decades. It sells technology from British labs. It buys technology on the international market for British companies.

And of special interest in these times of huge budget deficits, the British Technology Group makes a very substantial profit on its activities.

Mr. Chairman, I would offer you responses to a survey my staff made of federal laboratory transfer activity. The results, which should be available in published form within 45 days, were derived from questions we asked of 10 federal executives, each of whom manages portions of the sprawling federal lab network. We asked specific questions regarding level of transfer activity at individual labs. The survey also will identify key managers in those labs who are involved in the technology transfer process. I think this will be useful in your work.

I'm very pleased that your committee is responding to these important problems. I hope that together we can find some practical solutions. Thank you.

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September 1, 1989

TO: Ron Wyden, Chairman, Subcommittee on Regulation, Business Opportunities and Energy

FROM: Subcommittee Staff

SUBJECT: Transfer of Federal Technology to Small Business:

Serious Barriers Block Commercialization of Billions of Dollars in Federal Research and Hamstring U.S. Industrial Competitiveness

Mr. Chairman:

Over the last year, the subcommittee staff at your direction has investigated the role of the federal laboratories as drivers--or brakes -- on the global competitiveness of technology-dependent U.S. businesses. You have asked us to review the success or failure of government laboratories to commercialize billions of dollars of federally financed technology. You have also asked us to investigate problems in this area specific to small businesses.

In summary, we have found that the government efforts in this area have been under-staffed, under-directed and only marginally focused.

The result has been frustrated government scientists who can't commercialize their inventions, discouraged businesses who can't get at valuable technologies and penalized taxpayers who have lost untold millions of dollars in unrealized licensing and royalty revenues.

Representative of this failure is the astoundingly small return federal taxpayers receive through commercialization of federal inventions. Royalties accruing to the government in 1988 from licensing of federal inventions and discoveries represented a return on research investment of only .00005 percent.

According to John M. Ols, Jr., a senior manager with the U.S. General Accounting Office who is overseeing a detailed performance analysis of federal tech transfer laws, many government labs and agencies "are at ground zero" in their efforts to conform to the substance of transfer mandates.

* The General Accounting Office has said that while each year the federal government spends over $60 billion in scientific research, royalties from commercialization of that research amounts to only $2 million to $3 million per year.

* One former, long-time Presidential science aide complained to subcommittee staff that less than 10 percent of the inventions created in government-owned and operated labs -- funded at about $20 billion per year -- are ultimately transferred to private industry. Even less is finally commercialized into products.

* Some government agencies and labs have simply ignored key provisions of federal transfer laws. For example, some government labs have not yet developed rules and guidelines for commercialization of lab inventions -- a key step in the transfer of federal technology. According to businesses attempting to gain technology, other labs have assigned relatively low-level functionaries as tech transfer officers, and that these persons have little knowledge of inventions available or the transfer process.

* Finally, there is no top-level Administration executive with clear and overriding authority monitoring the quality of technology transfer efforts in federal labs. Staff believes that this fundamental gap in executive oversight allows individual labs and agencies to ignore the letter and the spirit of statutory tech transfer mandates.

The stakes in transfer of this vital technology are enormous.

The federal government finances 47 percent of the research and development in this country. Almost two-thirds of all federal research is done for the Defense Department, and much of the defense-related science is earmarked for highly-specialized, and not easily commercialized weapons systems. Nevertheless, the subcommittee's analysis indicates that the Defense Department's transfer record is among the thinnest -- for its size -- in the federal government.

One source told us that "DoD hides behind national security" rather than meet Congress' tech transfer mandates.

Our research also indicates that by comparison our chief economic rivals in the West are far more efficient in transferring the fruits of their government research to domestic industry. We believe that this transfer gap is already eroding America's ability to compete in global markets involving semiconductors, metallurgy, drugs and a number of other intelligence-driven businesses.

> Dr. James G. Ling, a former assistant science director in the Reagan White House, told us that "a wealth of technologies being researched and developed in federal labs simply isn't getting to the private sector." Ling observed that transfer efforts at federal labs are "modest, of variable quality and typically passive."

Drs. Barry Bozeman and Maureen O'Neill Fellows, faculty members at Syracuse University and the State University of New York, said in a recent study that there is reason to believe that "significant barriers to government laboratory technology transfer remain" in spite of various policy initiatives in recent years.

To illustrate some of these problems, staff submits three anecdotes which underscore our government's dispersed, uncoordinated and often lackluster technology transfer efforts:

1. Lack of leadership at key labs. For a time, the Army Corps of Engineers research center in Illinois had a model technology transfer program -- thanks largely to the aggressive and positive efforts of the center's commander, Colonel Paul Theuer. Theuer sought out commercial customers for the lab's structural materials inventions. When Theuer left, however, the center's technology transfer activity became negligible.

2. Over-dependence on centralized administration. Neither the Defense nor Agriculture departments delegate transfer authority to individual labs, a decentralization which could speed transfer and which is allowed and encouraged under the Federal Technology Transfer Act of 1986. As a result, months or years may pass before decisions are made on individual tech transfers as the paperwork ambles its way through headquarters offices in Washington, D.C. In one instance recounted to the subcommittee staff, an applicant literally went out of business because a key piece of technology sought through the USDA was not transferred soon enough to meet a deadline for an initial public stock offering.

3. A lack of administrative and legal support for government scientists with commercially valuable inventions. Subcommittee staff was told of instances in which government scientists were forced to leave their public jobs in order to commercially exploit their findings. A National Institutes of Health researcher discovered important healing properties in the skin of amphibians, and began the process of turning his discovery into a drug. But NIH lacked the administrative and legal support, and perhaps the desire, to help. The process became fraught with bureaucratic roadblocks, including suggestions by NIH administrators of possible conflicts-of-interest. The researcher, who had worked for NIH a dozen years, was forced to leave his federal job, join a university and then develop a partnership with a private drug firm in order to commercialize the breakthrough.

Staff believes that the obstacles not only lengthened the time it will take to bring this drug to market -- and perhaps to save lives -- but also cost NIH the services of a top-flight scientist.

Complicating our assessment of technology transfer in the federal government is the absence of substantive, evaluative data. The most recent independent study on federal tech transfer was done by the General Accounting Office, and released in June 1988. The GAO noted that even the definitions describing tech transfer differ from agency to agency, and lab to lab, making comparable audits difficult if not impossible. The GAO is undertaking an additional review to resolve this fundamental barrier to evaluation.

Why has American business, awash in federally funded research, lost its edge in the global economy? Obviously, macroeconomic forces (the value of the dollar and the fiscal deficit, for example) have played a role. The inability of many businesses to make effective use of government-funded technology, however, has exacerbated the disturbing downward spiral in high technology.

Staff has talked to scores of analysts, entrepreneurs, past and present federal administrators, federal and non-federal laboratories directors, trade association executives. Through that research, we can suggest the choke-points in the federal technology transfer stream:

* There is a traditional disinterest by laboratory personnel toward commercialization opportunities. Transfer of government technology runs counter to the traditional mission of government labs. In some labs, this tradition has been successfully overcome. In others, there is built-in resentment by scientists involved in pure research to transfer goals.

* In many labs -- and within some government agencies -- there is little or no positive administrative direction on tech transfer issues. Managers at some labs haven't even established regulations for transfer of intellectual property mandated by the 1986 Tech Transfer Act. According to the SUNY report, only 26 percent of federal labs have in-house policies. And 49 percent of the labs have only one part-time person assigned to tech transfer functions.

* The government often discourages commercialization through the general reporting of innovations. Exclusivity of intellectual property encourages commercialization. Unfortunately, in many cases the National Technical Information Service reports on inventions before companies bid on them, diminishing both efforts to commercialize and the likelihood that the inventions will result in successful products.

In its efforts to be fair -- to broadcast its findings in the most non-exclusive fashion possible -- the government erodes or eliminates the value of its basic research.

* Concern regarding ultimate liability involving consumer product safety issues keeps many government inventions from being commercialized. Although the federal government has "sovereign immunity" in such cases, independent labs working for the government do not. In order to protect these valuable research partners, the government often withholds the fruits of such research from commercialization.

* Some agencies are reluctant -- even opposed -- to giving up their technology. Under the Bayh-Dole Act of 1980, independent labs (run by small or nonprofit businesses) doing federal research may retain their right to inventions. Knowledge is power, however, for the contracting agencies, and in granting bids on federal jobs those agencies give preference to laboratories which agree to give up ownership to resulting technology.

As a result of this hit-or-miss approach, technology stays in the labs and out of the marketplace.

* There is no centralized clearinghouse -- or management -- of federal technology and transfer policy. Each lab has been left to devise -- or choose to ignore -- the goals and the process for technology commercialization. Businesses attempting to gain access to these technologies are faced with an array of conflicting and confusing rules, often enough to completely frustrate interested private purchasers.

In some cases, the sheer volume of technology developed, and the haphazard way in which it is unleashed on the market, can be a problem -- especially for small businesses.

Anthony Bratkovich of the National Machine Tool Builders Association summed it up in an analogy: The government dumps a truckload of dirt which contains 10 grams of gold. Most small businesses -- and even some large ones -- don't have the resources to sift through the technology available to pick out the knowledge which has commercial value. And most of the labs and agencies have little interest in helping out.

Failure to transfer technology seems built into the system.

Even senior managers of the National Institute for Standards and Technology -- a key promoter of government technology transfer-- complain about the attitudinal problems at some labs.

George Lewitt, NIST's chief for energy-related inventions, told subcommittee staff that the labs aren't interested in tech transfer because they see their main duty as pure research. Lewitt was particularly critical of the Department of Defense and the National Aeronautics and Space Administration, calling their commercialization efforts "evasive."

A recent report on the problems of technology transfer by the National Center for Manufacturing Sciences underscores the problem:

"In the United States, there isn't nearly the same degree of interaction between government and industry in commercial ventures as there is in the defense sector. The federal government does not participate so actively in the conduct of commercial R&D. In comparison, the governments in Japan, Korea and Taiwan, and to a lesser extent in West Germany, provide their industries with needed guidance, coordination and financial support."

In too many cases, we do not.

THE FEDERAL LABORATORY NETWORK: A COMMITMENT TO SCIENTIFIC EXCELLENCE

The government has long been committed to funding scientific research and development. The first laboratories, created by the Department of Agriculture in the 1800s, helped to usher in the era of scientific farming management. Countless farmers benefitted from the transfer of modern farming innovations, such as pesticides, advanced equipment, and crop rotation.

The labs approached their modern form during and in the years following World War II. The Manhattan Project required a concentration of scientists, in such places as Los Alamos and Oak Ridge. These makeshift labs evolved into what are now the Department of Energy's national laboratories. World War II and the Cold War also greatly expanded the need for Department of Defense laboratories and procurement practices. From that time, the labs were expanded and shuffled around various departments. Today, over 700 facilities in varied departments, agencies, and universities comprise the federal laboratory network.

The labs can be organized broadly into three categories: government-owned, government-operated (GOGOs); government-owned, contractor-operated (GOCOs); and contractor-owned, contractor-operated (COCOs). The Department of Health and Human Services (HHS), parent organization of the National Institutes of Health (NIH), is an agency employing mostly GOGOs. The Department of Energy (DOE) uses mainly GOCOs, which are run by corporations and universities. The Department of Defense (DOD), with its far-reaching procurement scheme, relies mostly on outside contractors, or COCOs, for development work, and GOGOs for basic and applied research. The distinctions among the three groups are significant; each has its own advantages and disadvantages and is treated differently under the law.

TECHNOLOGY TRANSFER: THE NUTS AND BOLTS

Commercialization can happen through a number of mechanisms, some more effective than others. Experts and companies agree that the most valuable means of transfer involve person-to-person interaction and exchange, rather than the mere transmission of data. Often, however, government labs rely on less successful methods:

* Technical assistance. Sometimes effective. Major drawback: Requires on-site visits to labs by the acquiring companies.

Typically, this occurs via a technical center or consulting firm which fields requests from businesses. The responses vary from center to center. Some centers are only research facilities, whereas others are capable of on-site visitation for highly specialized help. Most of these facilities are run privately, but several operate on federal grants. Often, firms need more individualized attention than technical centers can accommodate.

* Demonstration. Impressive on paper, but few concrete success stories. Many federal agencies and labs have turned to demonstrations (i.e. conferences) in order to notify businesses of otherwise hidden innovations. Because they often "push" technology to a disinterested business community, conferences are necessarily constrained in what they can accomplish. Little relationship between technical offering, and reality needs.

* Licensing. Relatively successful depending on the degree of freedom exercised by individual labs -- and the zeal with which lab directors pursue commercialization opportunities.

In some instances, federal inventions are patented. The licensing of these patented inventions for commercial use occurs infrequently. An effective patenting and exclusive licensing process is important because the licensor is able to facilitate commercialization. In other words, the licensor -- in this case, a federal laboratory -- can choose that licensing path that will best encourage commercial marketing. On the other hand, if commercial rights are granted non-exclusively, then a producer may be unwilling to invest in marketing research, only to see its competitors copy the additional developments.

Therefore, the key element is flexibility. Licensors must be empowered to pursue the most advantageous avenue toward product development.

One other advantage of licensing is the revenue it produces for a laboratory. When coupled with royalty sharing with the inventor, this may provide a powerful incentive to labs.

Licensing is not without its drawbacks, though. The licensee acquires only the technical data involved in a particular product or process, so the "know-how" behind the product remains in the lab. Furthermore, unless the process is targeted specifically toward small businesses, large corporations seem to have an advantage.

* Publications and databases. Although databases and publications are the easiest and cheapest way to advertise federal inventions, the effectiveness of this method is slight. Typically, businesses can learn the most basic scientific developments as well as where to look for more advanced ones. Since person-to-person contact is practically nil, however, only very simple developments may be transferred. More complex technologies remain on the shelf.

* Cooperative research and development agreements. Known as CRDAs, these agreements are by nearly all accounts the most effective transfer mechanism. Under a CRDA, company research and development representatives work alongside government scientists. Thus, the requisite personal contact is maintained at the highest level. Both the participating company and the laboratory benefit from such an arrangement. While CRDAs are not suitable in all cases, the number of agreements is a barometer measuring the efforts of laboratories.

CLOSE BUT NO CIGAR:
PAST LEGISLATIVE EFFORTS PROMOTING TECHNOLOGY TRANSFER

"Technology transfer" is not a new phrase or a new idea. Periodically, Congress has sought to squeeze more out of its investment in the federal labs. These haphazard legislative stabs have had incremental effects, but the nature of the problem remains. As several sources attested, the laboratories will be slow to respond to congressional efforts as long as transfer is apart from the labs' main mission. Due to half-hearted laws and improper implementation, many scientists are not sure what that main mission is. Still, past legislation affects today's transfer decisions. The most significant included:

* National Aeronautic and Space Act (1958). One of the justifications of the space race was the potential for commercial application of military and space research. Thus, NASA has always been charged with promoting technology transfer. The high expectations of the 1960s, however, went largely unfulfilled. Businesses seemed uninterested in basic scientific developments, which required an investment in large commercial research.

* Bayh-Dole Act (1980). In 1980, concerns about competitiveness prompted further consideration of laboratory research and development. Bayh-Dole represented a dramatic shift in the rationale for GOCOs, or contractor-operated labs. Under the act, the government could grant the contractor exclusive rights in the commercial marketplace if doing so would be necessary for an invention to reach the market.

Previously, all unclassified inventions resulting from federal funding were placed in the public domain; the people were entitled to what they, through their tax dollars, had funded. This "fair" system, however, actually stifled commercialization. Paradoxically, limiting commercial rights to fewer companies actually increased the likelihood of product development. Businesses are hardly eager to conduct expensive research beyond that done in the lab when competitors can easily copy the results. Bayh-Dole attempted to address these concerns.

* Stevenson-Wydler Act (1980). Stevenson-Wydler was a long-overdue attempt to establish some uniformity among the federal agencies. For the first time, Congress explicitly called for "the Federal Government to ensure the full use of the results of the Nation's Federal investment in research and development." As a result, technology transfer became part of the laboratories' main mission. Specifically, 0.5 percent of each lab's research and development budget was to go to an Office of Research and Technology Applications (ORTA). Each ORTA would designate those technologies which might have applications elsewhere.

* The Federal Technology Transfer Act (1986). Amended Stevenson-Wydler to permit federal agencies to delegate authority to federal labs to enter into cooperative R&D activities with the private sector. Creating incentives for federal scientists, the act also provided for royalty sharing on their inventions and discoveries. The act also required regular reporting by federal agencies on tech transfer activities.

* Executive Order 12591 (April 10, 1987). Allowed agencies to delegate authority to individual labs to enter into cooperative R&D agreements.

COMPLICATIONS, DELAYS AND ROADBLOCKS:
A STAFF SUMMARY OF TECH TRANSFER OBSTACLES

Three years after the latest major legislative fix, much federal technology useful to commercial interests gathers dust on the shelf. Here is a short list of major impediments and difficulties to the transfer of government-owned technology to American business:

* Ineffective management from the White House. The White House Science Advisor -- the nation's chief technology officer -- has not taken the lead on tech transfer, overseeing the efforts of the executive departments and agencies.

* Unclear, and sometimes conflicting directives on transfer from top-level agency and lab officials. No agency's transfer efforts can be taken seriously unless the cabinet-level (or equivalent) official makes an authoritative statement affirming the priority of transfer activities. There is no outright requirement within the law for this. As a result, there are few detailed policies handed down from cabinet-level officials dictating aggressive transfer efforts.

* Vacancies in many technology posts in the federal departments. Currently, several important technology posts-- including the Undersecretary for Technology in the Department of Commerce -- are vacant. We have been told by former Commerce officials that the agency has all but dropped technology matters.

* Micromanagement of laboratories' activities. Although agencies must emphasize the importance of transfer, the labs should have authority over their own technology. In many cases, technology transfers -- case by case -- are decided by headquarters officials in Washington, D.C., causing delay, frustration and ultimately failure for commercialization efforts.

* Slim incentives to inventors and laboratories. Despite significant leverage in this area granted to federal labs and agencies, federal inventors have realized few significant returns from the occasional commercialization of their discoveries. Labs have few administrative and support mechanism to help these inventors. Some scientists said they were forced to leave their federal jobs in order to commercialize their findings.

* Lack of preference to federal contractors who promise to commercialize technology. Although the spirit of the Bayh-Dole Act requires that agencies -- particularly the Department of Defense -- encourage contractors which work for the government to keep and use the resulting inventions, federal contract administrators often give preference to companies which promise not to commercialize their inventions.

* Federal labs do a poor job in advertising their wares. Businesses are unaware of the possibilities opened up in the last decade because labs are not actively seeking out opportunities for commercialization.

* The non-exclusive nature of federal technology offerings. When labs do offer inventions, the method is often public disclosure -- a means that necessarily cheapens the value of the technology to individual businesses. Often this is a guarantee that the technology will not be commercialized.

SUGGESTED MODEL PROGRAMS

We believe that some barriers to transfer require additional legislation. Potential legal changes include:

* Creation of a technology czar at cabinet level -- or within the White House -- with powers to enforce transfer laws. The Secretary of Commerce's role -- or the White House science advisor's -- could be broadened from advisory and oversight to include enforcement duties with reporting responsibility to Congress. This role must supersede jurisidiction of other agencies in transfer matters.

In essence, the secretary would be a hammer enforcing transfer policies throughout the federal laboratory system, rather than a passive advisor on commercialization efforts.

* Consolidation of technology-related agencies into a Department of Technology. Several organizations -- NIST, NTIS, the Federal Laboratory Consortium, Small Business Development Centers, parts of the Department of Energy-- are strewn throughout the executive department. A new department would streamline transfer efforts and would send a message to the labs -- and to our foreign competitors-- that America is serious about flexing its technological muscle.

* Establishment of a single, independent technology brokerage. One entity should be a reserve for government-owned information with commercial potential so businesses can keep track of the mind-boggling array of laboratories. A strengthened, independent NTIS could play the role of such a technology bank. This brokerage would also lend administrative and legal support to government scientists and interested businesses, and generally serve an advocacy role on tech transfer matters.

* Authorization and funding for independent, regional technology centers to bridge the Development Gap. Currently, technology coming out of the federal labs is too basic for most businesses to use. Technology centers based near federal laboratories would conduct commercial research on the most promising technologies, thus reducing the risk taken by business.

As an added attraction, these centers could become self-sufficient in an estimated 5-10 years. Revenues would come from royalty agreements with producers.

* Relaxation of antitrust laws. Small businesses are at a serious disadvantage because of their lack of resources, time, and risk potential. Allowing groups of small businesses to cooperate on research, development, and production would maintain their flexibility and entrepreneurial potential -- while fostering their adoption of new technologies. We feel that H.R. 423, the antitrust bill you authored, would achieve these goals.

* Revision of the Freedom of Information Act. While, in most cases, "sunshine" makes the government more accountable to the public, it can be the deathknell of proprietary efforts. One solution would be to protect trade secrets from disclosure under FOIA, thereby making government inventions more valuable to the individual entrepreneur--and more likely to be commercialized.

* Increased emphasis on cooperative R & D. Cooperative research and development agreements, allowed under the tech transfer act, are perhaps the most effective means of commercializing government inventions. Staff notes that too often, however, labs are dragged into these agreements. As a matter of policy, federal agencies must aggressively pursue these opportunities.

Senator GRASSLEY. I appreciate your testimony. There are very few questions we deal with here that somehow money does not work into them, and to have your suggestion that money is not a solution to the problem ought to make our job a little bit easier.

I have no questions of the distinguished Chairman of the subcommittee from the House. I will call on Senator Kasten.

STATEMENT OF HON. ROBERT W. KASTEN, JR., A U.S. SENATOR FROM THE STATE OF WISCONSIN

Senator KASTEN. Mr. Chairman, I first of all ask to have my opening statement be made a part of the record. Second, I just want to say that we can work this out. I do not know enough about the British system—I have read briefly about it different places, but included in your testimony and included in other testimony is more information about it. This is a way that in effect we get a full profit system going that can be involved in this technology distribution. And to me that makes a whole lot of sense. The database information that some of the small business groups have talked about makes sense also. I look forward to working with the Subcommittee toward a solution. Thank you, Mr. Chairman.

[The prepared statement of Senator Kasten follows:]

STATEMENT

BY U.S. SENATOR BOB KASTEN

HEARING ON TECHNOLOGY TRANSFER

Thank you, Mr. Chairman.

Right now this country is engaged in a critical battle -- a battle to regain our international competitiveness. The ability to use the technological developments of the coming years to make our economy more productive and efficient is vital to winning this fight.

But today, the pioneers of economic growth in America -- our small businesses -- our being denied access to vital technology by ineffective federal policies.

The facts are clear. Government owned and operated labs are funded at the rate of $20 billion a year. But less than 10 percent of the inventions created in these labs are turned over to the private sector!

America has the best and brightest when it comes to science -- we all know it. Our trade difficulties don't come from a lack of technological know-how, but from an inability to take these new ideas and turn them into successful commercial products.

Barriers to getting new ideas into the hands of private industry must be torn down.

I look forward to today's hearing, and to discussing how current federal law can be modified to allow a freer flow of technology to our nation's small businesses.

* * *

Senator GRASSLEY. Senator Wallop.

STATEMENT OF HON. MALCOLM WALLOP, A U.S. SENATOR FROM THE STATE OF WYOMING

Senator WALLOP. Mr. Chairman, thank you, and let me ask too that my statement be made a part of the record.

Mr. Wyden, I admire your opening statement. One of the things that just continues to strike me is how terrified the bureaucracy is of profit. And a really sort of innovating with—integrating their thought process with those of the private sector which theoretically they are designed to serve, and I do not know quite where you go to break down that inhibition and that fear. We see it in Wyoming.

We put together something called Amendment 4 monies which was theoretically to be the Wyoming sort of Investment Capital Program. But as soon as you mix politics with it, something weird happens, and ordinarily sensible people become quite spellbound by the idea that if somebody makes a lot of money with something that has a public initiative that somehow or other that is wrong. That seems to be the biggest thing we have to go over.

The British model may be the thing that we do, but we still have to break down a sort of intellectual inhibition against mixing public expenditures with private profit. But until we do, we will not have any benefits from it.

Mr. WYDEN. Well, I sure think, Senator, that you are on target, and not only do I agree with the theory, but what we also heard on our hearing is that our big competitors, particularly the Europeans, the Germans and the Japanese, they have no such inhibitions. They are not at all restrained about using their government-funded innovations and technologies to commercialize them with the private sectors.

And one of the strongest statements that we got really indicting our whole system is not only do the Germans and the Western Europeans and Japanese do it with their system, they are now basically getting our technology off the shelf while we still sit here with all these bureaucratic log jams and do not go forward with commercialization.

Senator WALLOP. Making their private profit with our public initiative that we are somehow—we have our intellectual constraints from doing that. We are onto it. I do not know what we do to move it, but that is what the key is.

[The prepared statement of Senator Wallop follows:]

STATEMENT BY SENATOR MALCOLM WALLOP

BEFORE THE SENATE COMMITTEE ON SMALL BUSINESS

TECHNOLOGY TRANSFER AND SMALL BUSINESS

THURSDAY, MARCH 8, 1990

I thank the chairman for holding this hearing today. I'm pleased to be a part of our efforts to examine technology transfer issues and discuss their impact on the ability of American businesses to compete in the global market. Technology transfer means many things to many people, but to small businesses, it can play a major role in the development and commercialization of a product and the continued growth of a company. If American businesses -- large and small -- are to become a more viable force in the world market and enable us to reduce our trade deficit, I believe our federal laboratory system must serve as a funnel to achieve that end.

As a member from a rural state like Wyoming, which has the largest number of small businesses per capita, I am concerned that our technology transfer efforts have not focused sufficiently on small business contact from the federal level. The federal role in creating a demand for technical assistance to small businesses is ill-defined.

As such, the state and local governments have attempted to make up for that lack of outreach effort. In fact, for the last two years, Wyoming Small Business Development Centers have been part of a pilot project aimed at increasing the development of technology and its application to the operation of small business concerns via technology transfer.

Since Wyoming was one of the more successful states in enhancing outreach about methods of technology transfer, it is now a "mentor" state and shares its outreach expertise with other states. This effort is augmented by the National Institute of Standards and Technology (NIST). NIST evaluates inventions from inventors and small businesses and identifies those which warrant government support because of their potential energy benefits. As I understand it, NIST recently recommended to the Department of Energy a Wyoming invention designed to remove acid rain from lakes in a more energy efficient manner. I am encouraged by this cooperative effort and trust that we will continue to foster product development in all sectors of the economy.

While I delight in these initiatives to develop energy-related inventions, at the same time, I do not understand why we are not focusing on non-energy related inventions as well. For instance, in FY 90, NIST was only allocated $150,000 for the non-energy related inventions program and the program has been proposed for elimination in FY 91. I am troubled by that, because a number of good inventions are rejected by NIST because of their low potential for energy savings.

Over the last several months, at the request of the Casper Chamber of Commerce, I have been working with a network of small manufacturers in an attempt to help them develop and market their products, most of which are not related to the energy field. If we are to further our trade activities in the Pacific Rim and the emerging Eastern European countries, we must continue our efforts to improve small company access to information on new technologies other than those strictly related to the energy field. And, as we struggle to balance our budget, we must learn to use limited financial resources in a more judicious manner. We can do that by broadening the scope of our technical assistance to businesses and I hope the Department of Commerce will make an effort to focus on this aspect of technology transfer.

I look forward to hearing from the witnesses here today on how we might best improve our technology transfer efforts and provide more innovative guidance to industries. I'd also like to welcome Mac Bryant today. Mac is here from Casper, Wyoming and as the state director of the Small Business Development Center, will share with us his perspective of how technology transfer activities can be improved in rural parts of the country like Wyoming. I look forward to his testimony and thank him for his time and participation in this hearing.

Senator GRASSLEY. Before I call on Senator Burns, could I take care of an administrative matter?

I took over at the suggestion of staff while we were waiting for Senator Boschwitz to arrive, and I have to go to the Budget Committee. Will one of you folks be able to stay and chair until he gets here?

Senator BURNS. Are you asking permission for you to go or are you telling us you are going to go?

Senator GRASSLEY. I assume some responsibilities which I do not want to shirk, and you would be helping me keep my commitment.

OK, also before I call on Senator Burns, I am going to leave questions for answer in writing by Dr. Bromley, and also by Mr. Mercer when he is at the witness table. I would like to have those responses in writing, and I call on Senator Burns.

STATEMENT OF HON. CONRAD BURNS, A U.S. SENATOR FROM THE STATE OF MONTANA

Senator BURNS. Thank you, Mr. Chairman.

And Congressman Wyden, I appreciate your time coming over here today, and I think you are onto something. I am just new here, and I have not really thought about this Technology Transfer and how we start dealing with that, but I just want to make a short statement, and I may be completely off base and if I am, then the dialogue that we will develop today will probably bring me back on track.

But there is some concern, I think, in this Government or with this Senator, anyway, the amount of money spent and the amount of money returned on the technologies that we have developed in Government labs, and I do not know why that would be.

I was talking to the Energy Department the other day and saying that there was one piece of technology they have developed there, and actually it was—they have only been bid, so to speak, a nominal price for that technology which in my estimation is worth a great deal more than what they were offered for it.

And I get the feeling that the private sector has been reluctant to pay for this technology its fair market value believing probably that it was the taxpayers' money that developed it, and in essence it was their tax money, so it should be dispensed to the proper industry at a nominal fee. I do not know whether that is a mindset in the private sector or not.

And then sometimes I think the private sector probably is unaware of what technologies are available or are on the shelf so—and it may be a combination of all of these factors that we will talk about today.

I think the private companies should understand that those technologies have—they have worth and should be expected to pay market value for it.

Now basically here is where I think the problem comes down to from what little I have looked at. The Government has not been a very good salesman.

It seems like we in the political sector, we have a pretty good—we get along pretty good at selling ourselves to be elected. But when it comes to selling a product, sticking that product in a brief-

case and jumping in a car and going door to door to market these technologies, we have not done that very good.

In other words, if you could probably put somebody in charge of an office and he is a salesman for the Government on these technologies and you put him on a commission—I will tell you why—I think we would see some things happen in the private sector, so to speak.

We have no central point of collection for these technologies because they are over in Commerce, they are over in Energy, they are in Defense, they are spread out through the Government where tnis research has been done. There has been no central point of collection so that we can catalog or list what is available for the private sector for private use to put a product on the market, and I do not know what we would run into like security and all of this. I do not know what you would run into whenever you get into a situation like that.

Those are just some of my thoughts on this, and there may be some way we could deal with it. But it just sounds like to me that we have not been that good a salesman on the product that we have, and so that is my opening statement and I will be happy—I would just like to say I might be way off, but the dialogue may bring me back on track.

So, I appreciate your efforts on that, and I will have a couple of questions as the dialogue progresses.

Congressman WYDEN. I would make a couple of comments, Senator, if I could.

I think you are very much on track with respect to this profit issue. And that is one of the reasons that I suggest looking now at the British system which is a quasi-independent technology brokerage that really puts the focus on profit.

I do think that our businesses will be willing to pay the market value for these new technologies if they can find out where in the heck they were.

And that is why in the testimony that I offered I recommend that we look to establish a national database so that in one centralized place we could in effect have these technologies and innovations chronicled. If you are in Oregon or Montana or South Dakota and you are interested in getting one of these technologies because you see a niche for your business there, you would have a centralized place to look.

And it does come down, as you say, to a question of having a salesperson for our investments.

I think if the taxpayers knew that we were spending $60 billion for research and getting a rate of return of way, way under 1 percent, I think they would be livid. I think they would say we are really frittering the money away.

So, it does come down to a question of being a salesperson for our investment, and I sure think your comments and that of all of the Members are very much on target.

Senator WALLOP [presiding]. Mr. Pressler.

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STATEMENT OF HON. LARRY PRESSLER, A U.S. SENATOR FROM THE STATE OF SOUTH DAKOTA

Senator PRESSLER. Mr. Chairman, I shall place my opening statement in the record in the interests of time. I did want to compliment our witnesses. I am very interested in this subject, for I also serve as Ranking Member of our Science Subcommittee on the Commerce Committee.

Ron, I really appreciate your testimony here, and I was intrigued with your point on creation of a technology czar.

I would hope that our fine science advisors could work on developing this job with the help of the Secretary of Commerce.

But I think your suggestions are good. This is really a problem we have as a Nation in terms of competing scientifically, and I think that getting small business much more involved through the private enterprise system and other steps is just critical. I very much appreciate both of these witness and, Ron, your statement. I think it is just excellent, this additional memorandum you submitted from your Committee staff, I believe. Who is this memo from?

Congressman WYDEN. That is from our Subcommittee, our staff director, Steve Jenning over there, who has been working very closely with your people.

Senator PRESSLER. Yes, I just read through it.

So, Mr. Chairman, I ask unanimous consent to place my statement in the record.

I hope to be back after I render the Banking Committee to a hearing that I requested, so I have to appear there, and I thank you very much.

[The prepared statement of Senator Pressler follows:]

STATEMENT OF

UNITED STATES SENATOR LARRY PRESSLER

BEFORE THE

COMMITTEE ON SMALL BUSINESS

MARCH 8, 1990

Mr. Chairman, I am pleased that this committee will have the opportunity to examine the important question of the transfer of technology to small businesses. I also welcome my colleagues, Senator Rockefeller and Congressman Wyden, who have done so much work in this area.

We live in the Information Age. There is no question that our country is a world leader in research and development, with substantial assistance from the federal government.

To maximize this resource, small business must have access to this research pool. Recent studies bear out the fact that our economic future is directly tied to the development and use of technology. Small business does have a role to play in technological innovations. Today's hearing is an important step in encouraging the cooperation of the federal government, academia, and America's small business people in sharing technology.

Senator WALLOP. Before you go, Ron, let me just say that there is a semantical difference perhaps, but what we need is less a czar than a businessman, somebody who can understand the various kinds of ways in which the United States interests can be maximized on a straight arms' length business deal—you know, a combination of salesman and someone who understands that there are royalties or overrides, there are straight purchases, there's licensings, there is all different kinds of ways in which we could do this.

And I think too often those perfectly honorable people who serve in Government do not have other perfectly honorable American experience of being in the business world and are reluctant to try those innovations and when we can get to those, I think we will all be better served.

Congressman WYDEN. I think your comment is a fair one. I think that as we talked with the staff of the majority and minority over in the House, one of the things that we were saying was more than anything we have got to get people's attention, and unfortunately in this town unless you call something a czar or something, nobody seems to pay any attention.

Dr. Bromley, of course, is our czar. This is his beat, and I think that if we could get the blueprint—and we have been talking to Dr. Bromley about that—then get that Undersecretary of Commerce for Technology position filled, the one that has been vacant for 14 months, then we can get on to the business-like decisions that you and Senator Burns are talking about, along with Senator Pressler.

Senator WALLOP. Thank you very much for your testimony.

Dr. Bromley.

STATEMENT OF DR. D. ALLAN BROMLEY, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Dr. BROMLEY. Thank you, Mr. Chairman. I welcome this opportunity to come to talk to this Committee about some of the Bush Administration's views on the commercialization of government-sponsored technology, particularly as this applies to small businesses.

The whole issue of competitiveness of our national industrial base, of course, is one of my paramount concerns in my office, and it is to a great many other Members of the Administration and of respected associates here in the Congress.

In fact, there are few more important issues as I see it, that my associates and I in OSTP have to address than this one. And the United States really has created and nurtured the finest research and development establishment in the world.

We have done that with generous support from the Congress and through you, from the U.S. taxpayer, and we do have a scientific enterprise that is the envy of the world. I would particularly make the point that the Federal Government laboratories represent really an astonishing breadth of expertise, talent, and technology. It is the best that is available across the spectrum anywhere in the world.

However, you were quite right, gentlemen, that a technology base is very different from other resources. It has no real value unless it is used.

Now I think that we do have legislation—I agree with Congressman Wyden—we have legislation in place that should make it possible for us to do the things that all of us, I think share as common goals. We have the Stevenson-Wydler Technology Innovation Act of 1980; the Bayh-Dole Act of 1980 as amended in 1984; the Federal Technology Transfer Act of 1986; and the National Competitiveness Technology Transfer Act of 1989.

I would submit to you, gentlemen, that these pieces of legislation really do provide us with all the tools we need to tap the reservoir of capability in our Federal laboratories. I think that the synergism that has been established already between some of the Federal laboratories—and I would emphasize some—some of the Federal laboratories and small businesses, I think, is very important.

We are making progress. It goes almost without saying, sir, that a great many of our small businesses do not simply have the resources to generate the kind of broad technological base that is required to make them competitive in today's international marketplace. They obviously can benefit from closer ties, closer communication, transfer of information and know-how from the Federal laboratories.

But I would emphasize a point that is frequently forgotten, and that is that the Federal laboratories have much to gain from improved communication with small businesses. Those small businesses in this country are the major source of innovation. They are the major source of new jobs. They have the entrepreneurial drive and excitement that I think is all important for us to get into our Federal laboratories.

So I see this as a very important benefit both ways, and am committed to doing everything that we can to improve that. But I think I need not really emphasize to you, gentlemen, that Technology Transfer by its very nature is an extraordinarily difficult business.

It is very difficult to make it happen within a single company. It is much more difficult to make it happen between and among different organizations.

In part this is bureaucratic inertia and in part, it simply demonstrates that we have not had adequately strong leadership and focus on this as a very important part of the mission of all these Federal laboratories. It is part of their mission, must be part of their mission.

The fact that today we have something like 200 active, cooperative arrangements in place between Federal laboratories and small businesses, indicates that the companies—200 companies is a reasonable number—believe strongly that there are advantages to them, but as Congressman Wyden indicated, in a statement with which I totally agree: In a great many cases the bureaucratic difficulties simply stymie, and frustrate small businessmen trying to gain access to the resources in these laboratories.

We are, however, I would submit, sir, beginning to see some rather remarkable new arrangements on a much larger scale. To take a particular example, I would mention the collaborative arrangement that has been set up by Hewlett- Packard, Dupont, and Los Alamos.

This is an arrangement to really examine high temperature super-conductivity and its potential applications. This is an $11 million cooperation and the two companies, Dupont and Hewlett-Packard are at the moment contributing over $7 million to this co-operative arrangement.

So there is, I think, a model that we must use much more widely. That is, of course, one that involves larger companies, but there are general principles established in it that can be extremely important as we move to the smaller ones.

As Director of the Office of Science and Technology Policy, as I have indicated since my initial confirmation hearings, I look on one of my major responsibilities as the emphasis of the "T" in OSTP.

It has not been much emphasized in the past, and as indication of that emphasis, for the first time my office is, I hope, going to have all four of the associate directors Presidentially appointed, Senate-confirmed, that were made available in the initial 1976 legislation.

In particular, I have designated one of those positions as Associate Director for Industrial Technology. I do that for two reasons: One, because I think industrial technology is enormously important, and secondly, because I want to send a very real message that the Bush Administration shares that view, and that we want a very senior person who is going to give this full-time attention.

The candidate who was nominated by President Bush, who had his confirmation hearings something over a week ago and whom I hope we can have confirmed in the very near future is indeed someone who has business experience—extensive business experience.

He is Dr. William Phillips who would come to the position from a background of extensive experience as senior executive vice president for research and development at Mallinkradt, preceded by many years as vice-president for research and development at Dupont.

His area of responsibility will be industrial technology, and of course, one of the things that we are working on even before both he and the individual we hope will be the new Undersecretary for Technology in Commerce are confirmed, is the common cause that quite naturally exists between OSTP and the Commerce Department. And so we hope to really be able to move forward as soon as those confirmations are in place.

One of the most helpful things, and Congressman Wyden emphasized this, one of the most helpful things that we can do in the Federal Government is to make it clear to everyone involved, to the directors of the national laboratories, we have 726 national laboratories. It is a number that always comes as a bit of a surprise; 726 national laboratories and if we have the directors of those laboratories firmly convinced that not only is it appropriate for them to be trying to make contact with businesses large and small, but that it really is part of their mission, then I think we will have made a step forward.

And it is critically important that leadership be throughout the system, from the agency heads to the laboratory heads, and fur-

thermore that that intention be made clear to the business people who hopefully will wish to be the recipients and the participants.

In addition to that, the Federal Government could do many other things that are very important in this particular commercialization and Technology Transfer arena. One of course is education. We have as one of our greatest problems in this country the fact that we no longer have an educational system that is providing the quality of education to our children that we enjoyed.

It is a scandal. It is also not providing the kind of education that will give us the workers, the professionals, the technicians that we need to be competitive in today's world or indeed to be even secure in today's world.

The President has obviously made education a major part of his program. His commitment was demonstrated at the Education Summit and the follow-up meeting with the Governors held just last week. In my own office I consider this sufficiently important that I have added a Science and Mathematics Education Specialist to our staff, specifically charged with helping to develop effective national initiatives in this area.

Another important area, again mentioned by Congressman Wyden, is the whole information infrastructure of this Nation. We have a window of opportunity, Mr. Chairman, that I do not believe will remain open all that long, that we must take advantage of.

My office submitted to the Congress last fall a report on high performance computing. That report had four very important components. The first, we must establish a base of utilization of high performance computing in this country, sufficient to provide stability for our domestic manufacturing capability in the super computer area.

Second, we must provide networks of high capacity fiber optics to make that capability available to a vastly greater number of our citizens than now have access to it.

Third, most of the people now using super computers are specialists in nuclear weaponry or in advanced aerodynamics or in what probably rightly would be called exotic areas and the software for these very powerful machines is anything but user-friendly. If we are going to make this available to small businesses and in particular, to education—I feel that that is our major opportunity because technology and education really has not changed all that much since about 1850.

We have to do something there. This is a case where we can do it. We have to make it user-friendly, and we have to recognize that we have a terrible shortage already and a growing one in terms of personnel who are competent to do the work in this information field.

One of the most startling statistics that I have encountered in recent months has been from a survey of the interest profiles of young Americans entering colleges and universities a year ago. What we found was that interest in any physical science has dropped by a third in the last decade. Interest in mathematics has dropped by a quarter in the last 7 years and interest in computer science has dropped by two-thirds in the last 4 years.

We have problems in all of these areas that are going to be extraordinarily important if we are going to be able to use the tech-

nology, the know-how, the science that we have in our national laboratories, if we are going to be able to use it broadly.

We simply cannot get the kind of cooperation we are talking about, if we have to simply go fly from point A to point B to get the information.

One of the problems that I think you would agree with, gentlemen, is that we have excellent legislation on the books, but one of the things we do not have is any quantitative measure of just what progress we have been able to make on the basis of that legislation.

My office is cooperating with OMB, with the Department of Energy and with the GAO in three important studies that have been initiated, that we hope will provide us the kind of information so that we can come back to you and tell you what has really been accomplished on the basis of this legislation.

Normally, OMB asks the agencies to tell OMB what amounts of money are being spent in various areas. This year we have agreed that OMB is going to ask how the money is being spent? Where it is being spent? Why it is being spent in this Technology Transfer area? It will provide us with a database that has not existed before.

With GAO there will be a retrospective look. What impact has the legislation that has been passed over the past decade really had on our competitiveness, on our industrial strength?

And finally, the Department of Energy has established a panel that is looking within DOE to see how best to implement the Domenici-Bingaman legislation and how best to get this technology that has been spoken about repeatedly this morning, out where it can be actively used both for economic competitiveness and for our national security.

There are some key barriers to Technology Transfer that seem to be almost as fundamental as the laws of physics, but I think we are beginning to understand what they are. The very phrase, Technology Transfer, in itself has done substantial damage, I believe.

Technology Transfer implies that you can wrap up technology at one place and transmit it somewhere, unwrap it and there it goes, it behaves. It does not.

Technology Transfer is a continuing process that takes place because people talk to one another, learn and carry the know-how with them, and we are never going to get Technology Transfer unless we figure out ways to have that kind of person-to-person contact, communication taking place between the industrial sector and the Federal sector.

Whatever else we may do is not going to work unless we recognize that Technology Transfer takes place as a rather personal individual thing.

Now what we really need it seems to me are entrepreneurs on both sides of this equation: Entrepreneurs in the Federal Government who will become convinced that it is part of their function to get this know-how out where it can be used; entrepreneurs on the industrial side who will challenge the people in the laboratories to help them to do what they are trying to do.

I think we have to pay particular attention to small- and intermediate-sized companies. They are the ones that I think can benefit most from changes. At the moment, the large companies, the major companies know perfectly well how to mine the resources of

the Federal laboratories, and they do it with great effectiveness in many cases.

It is the small organization that simply does not have the know-how or the manpower to just hang in there as they get circulated through repeated phone calls and loops in the Federal system. It is damn frustrating to put it bluntly, when you try to do it from the outside and we have to make it easier.

And it seems to me that we have made substantial progress in that direction with the offices that have been established in many of the Federal laboratories. We have the legislation that we need, I believe, to make this flow of know-how work.

What we do need in addition is a certain degree of flexibility, to be innovative in the ways that we fashion the working relationships between the research laboratories and industry and we need a reward structure.

We need incentives on both sides. In the business community they are in general already in place. In the Federal laboratory system they are not in place, at least in most cases.

We need a reward structure that makes it very clear that it is to the personal benefit of individuals to make this happen, and I think we have to build up the process and the mechanism that will put all of this together.

So let me then simply summarize if I may, gentlemen, that I think these first few years of responding to your initiative and passing the legislation that I referred to earlier, have gone principally into building the infrastructure for Technology Transfer.

We have education, communications systems. We have some model cooperative agreements. We have got proposals for data transfer systems. We have got a lot of this built up. These efforts are admirable in a great many cases and, of course, must continue.

What we need to do now is to do some more effective marketing and to get more people involved, get much more of our industrial sector involved in using the technologies we already have.

I think it is encouraging that we already have some pretty good examples where Technology Transfer efforts are paying back handsome fiscal dividends. Congressman Wyden was understandably averaging over the whole spectrum and I think we have to focus on some of the success stories because they are the models that other companies can and should use. I think that we have some good models to make available to them.

So that really completes my informal remarks, Mr. Chairman. I hope that my formal statement can be included in the record.

Senator BOSCHWITZ [presiding]. It will be, and we thank you very much for your testimony, Dr. Bromley. I quite agree with what you have said.

[The prepared statement of Dr. Bromley follows:]

STATEMENT

BY

D. ALLAN BROMLEY
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

BEFORE

THE UNITED STATES SENATE
COMMITTEE ON SMALL BUSINESS

ON

TECHNOLOGY TRANSFER AND SMALL BUSINESS

WASHINGTON, D. C.

MARCH 8, 1990

STATEMENT

by
D. Allan Bromley
Director, Office of Science and Technology Policy

before the United States Senate
Committee on Small Business

March 8, 1990

Mr. Chairman, I am pleased to have this opportunity to appear before your committee to discuss this Administration's views on the commercialization of government sponsored technology, especially as it relates to small business. The whole issue of the competitiveness of our national industrial base is of paramount concern to me, as it is to many others in the Administration and our respected associates in Congress. There are few issues more important for us to address jointly than competitiveness, and I have clearly stated my intentions to work cooperatively with Congress on such matters.

The United States has created and nurtured the finest research and development establishment in the world through its combination of government, university and industrial laboratory systems. The Federal government's laboratories, in particular, embrace an astonishing breadth and depth of the best science and technology to be found. This base of knowledge represents one of our most valuable national assets. However, a technology base is unlike many other asset: it must be put to use in order to be valuable. The Stevenson-Wydler Technology Innovation Act of 1980, the Bayh-Dole Act (1980, amended 1984), the Federal Technology Transfer Act of 1986 and the National Competitiveness Technology Transfer Act of 1989 provide mechanisms for us to tap this reservoir of capability in our Federal laboratories and put it at the disposal of our industrial producers, both big and small.

Indeed, the synergism established between our federal laboratories and small business may be especially important to our success. It almost goes without saying that our small businesses do not have the resources to generate the broad advanced technology base they may need to be the most successful. For instance, even if their products have outstanding technology in terms of product concept, they may need advanced materials and manufacturing knowledge which the Federal laboratories can help provide. However, there is an equally important reciprocal

benefit to the Federal laboratories. Small businesses are the most rapidly growing of our corporate enterprises because they have demonstrated a receptivity to new ideas and change, and because they operate in an inherently entrepreneurial style. These characteristics make small business very fertile ground for successful technology transfer from our Federal laboratory investment.

ADMINISTRATION SUPPORT OF TECHNOLOGY TRANSFER

Technology transfer is an extremely difficult process. It needs to be thought of as an ongoing and a continuing process rather than a discrete event. It is hard to transfer technology even within a large company, say from its research laboratories to produce one of its production divisions. It is even harder to transfer technology between organizations, especially when there are large bureaucratic obstacles or cultural differences to overcome. In these instances, leadership, commitment and vision at the very top of the organizations are essential to overcoming these barriers.

As I mentioned earlier, the federal laboratories are engaged in a wide variety of R&D activities. Some of these are in the realm of pure science, striving to improve our fundamental knowledge of the world around us and of the universe. Other activities are directed toward applications both for government use and for the private sector. The fact that today we have roughly 200 active cooperative research and development agreements between the Federal laboratories and private companies indicates that the companies involved believe in the potential commercial viability of the technology that they are co-developing. We are also beginning to see some remarkable collaborative arrangements: the $11 million DuPont/Hewlett-Packard/Los Alamos National Laboratory joint venture in high temperature superconducting materials and applications, in which the two companies are investing over $7 million, is a good illustration of these new arrangements.

OSTP'S ROLE

As Director of OSTP, I recognize the importance of the role that my Office can play in developing a Federal posture that will result in enhancing our industrial competitiveness. In fact, I have made that a major focus of my staff by dedicating several of the leadership positions within OSTP to competitiveness related issues. I have designated one of my four directorates to focus on Industrial Technology. The Associate Director of Industrial Technology will be a senior manager with an industrial background and an established record of achievement in technology management. Dr. William Phillips has been nominated to fill

that position; his confirmation hearing was held last week. I have charged Dr. Phillips and his staff with responsibility for several areas of emphasis dealing with competitiveness issues directly, including technology transfer and interactions with, and support of, state government technology initiatives. This group will also work to build and enhance interfaces with professional engineering societies and industrial associations that can provide key forums, opportunities and resources to help ensure the success of all current and forthcoming technology transfer initiatives.

Clearly, one of the most helpful things I can do to enhance the technology transfer process is to see that the view that I have of its importance is shared by other key Federal policy level managers who are in a position to help such initiatives. I also intend to exercise the leadership in technology transfer assigned to OSTP by President Reagan's Executive Order 12591.

Establishing interconnections between government technologists and the ultimate user community of U.S. industry is absolutely critical to achieving effective technology transfer. To use a sports analogy, technology transfer is a hand-off, not a lateral. The giving and receiving parties must have a close working relationship. The people responsible for this on the federal side are the directors of the Offices of Research and Technology Applications (ORTA) appointed by the various Laboratory Directors. These are the people actually working out the details of technology transfer, and they are critical to the success of the effort. One of their support organizations, the Federal Laboratory Consortium for Technology Transfer, has been making good progress, as indicated by the achievements noted in their last annual report, dated June 1989.

OSTP has several other initiatives underway that address competitiveness and that should favorably affect small businesses. Several of these address cross-cutting issues that affect the infrastructure supporting our national science and technology endeavors.

Education is one of these. We need to strengthen our entire educational process, to ensure that those entering the workplace will have the necessary knowledge, comprehension and problem solving skills for the highly technical content of the daily living and working environment of the future. We also need to ensure that industry will have a plentiful supply of talent at all levels. Critical among industry concerns is the anticipated shortfall of scientists and engineers and technicians. The President's Education Summit was intended to catalyze a national consensus on improving education, including science and mathematics

education. One of the national education goals that emerged from this Summit states that: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement." I consider this area so important that I have added a science and math education specialist to the staff at OSTP to assist with developing effective national initiatives to deal with these problems.

Another important undertaking for all of us is to enhance our information infrastructure by supporting the improvements to our high performance computing capability. One way to accomplish this is outlined in the program being coordinated by OSTP and described in the Federal High Performance Computing Program released last September. Information technologies, both hardware and software, will be the backbone of our business and social enterprises for the foreseeable future. High speed information networks, efficiently linking millions of individual corporate and private users to massive data banks and computing resources can have the same transforming effect on our country as earlier systems of communication such as railways, superhighways and telephones. Again, this capability will be especially important to the high technology, small business segment because it will give them the tools to access cutting-edge technology wherever it's developed. The Federal government also supports operational networks and network services. These are expected eventually to create a commercially viable market whose needs can be supplied by the private sector.

One of the problems we are faced with at the moment is that we do not yet have a quantitative analysis of our progress in technology transfer since the passage of the 1986 Technology Transfer Act. OMB is currently working to improve the reporting on these activities in order to get better data on costs, the number of cooperative agreements with industry, the amount of royalties and fees received by the government, and to identify improved standards/criteria for evaluating effectiveness of technology transfer. As part of its National Energy Strategy Plan, DOE has been reviewing its experiences with technology transfer in order to assess progress and formulate new plans and strategies to improve the Department's technology transfer process. The GAO is also undertaking a project to examine the implementation and effect of the legislation to gain a better understanding of our current technology transfer process and activities. My Office is cooperating with OMB, DOE, and GAO in these three important studies.

KEY BARRIERS AND RECOMMENDATIONS

The key barrier to technology transfer seems almost as fundamental and irrefutable as some of the underlying laws of physics, although it's an empirical observation. The 'transfer' that must take place is between two or more individuals in separate organizations, with fundamentally differing missions. The first, and most critical, step in technology transfer is that the potential providers and potential users of technology must be brought together. We have several initiatives underway that are letting our business community know about the technology we have available and the various avenues that are available for gaining access to this technology. These include everything from newsletters and electronic technology databases to workshops. And all these are producing 'hits'. But bringing people and organizations together so that they can discover each other remains the foremost challenge, and one that we must continue to stimulate. If we're successful in linking innovators in our federal laboratories to entrepreneurs in business, they will make the technology transfer process work.

Actually, we need entrepreneurs on both sides of the interface, in the sense that we need individuals with a vision of that which can be, and the strong personal drive to overcome obstacles to achieving their vision. Although we appear to have made a fair start, we have a lot of inertia to overcome on both sides, federal and private sector, if we're to realize the high potential that technology transfer offers. On the government side this means we must continue to champion technology transfer so that all layers of management involved in the process support technology transfer enthusiastically because they understand what it can achieve for the nation.

Another major challenge that we face is in dealing with the U.S. corporate culture. Intra-firm technology transfer within large corporations is not taking place to any great extent, much less inter-firm transfer. Thus, it is not surprising that industry is reluctant to seek out energetically technology transfer opportunities with the Federal government. There are some legitimate reasons for this reluctance, such as bureaucratic delays and questions of exclusive rights, but these are only a part of the problem. The larger challenge is to forge a constructive working relationship, in place of the often adversarial one that has existed between government and industry.

We also need to pay particular attention to small and intermediate sized companies because they can benefit significantly by having access to federally supported developed technologies. The mechanisms that we have in place today for technology transfer tend to be passive ones. I think we need to examine some more active approaches, including better federal-state cooperation, in order to make this process work. Building more, bigger and better data bases is not an adequate solution.

With regard to intermediate sized companies (that is, small businesses that have become successful), the Federal laboratories could be a source of new technologies that would help them continue to grow. Many of these companies have become successful by exploiting a single technology. Now, however, they do not have access to new ideas that would allow them to develop another generation of products. I believe that this is the biggest potential market for federal technologies and Federal technology transfer. My staff and I will be examining this idea further in the immediate future.

I believe we have most of what we need to make technology transfer work. We need in addition, however, a certain degree of flexibility to be innovative in the way we attempt to fashion working relationships between our research laboratories and industry, and we need incentives and commitments on both a personal and organizational level. The Federal Technology Transfer Act of 1986 and the National Competitiveness Technology Transfer Act of 1989 provided us with an excellent set of tools. Now we must build up a system of people, mechanisms, and processes to make it happen.

SUMMARY

These first few years of effort to implement an effective Federal technology transfer policy have gone principally into building the infrastructure for technology transfer: education, communication systems, model cooperative research agreements, etc. While these efforts are admirable in many cases and must continue, much of what we've devised appears passive in nature; for example, the government is prepared to respond to industry-initiated requests for information on available technologies. Now we need to develop a more active program for identifying and making known to the private sector the full range of available federal technology.

The time it takes for a particular technology to move out of the laboratory into the market, incorporated in a product, is usually several years and can be even decades. It is very encouraging that we already have several instances where technology transfer efforts are paying back actual fiscal dividends to the government and individual innovators. Fiscal returns are one important measure of the program's success, but the broader benefits to our society and the strength of our economy will be longer in coming and harder to measure. We must realize that this is inherently a long-term undertaking, and we must plan to stay the course with a consistent, constructive Federal policy.

The Stevenson-Wydler Technology Innovation Act of 1980, the Federal Technology Transfer Act of 1986 and the National Competitiveness Technology Transfer Act of 1989 give us the goals and necessary authority to promote commercial and public use of the science and technological resources of the Federally operated R&D laboratories. No assessments to date indicate any critical shortcoming of these laws, so I see no need for further legislation on this subject as yet. We still have not exploited all the latitude granted so far.

I believe that if we are to compete successfully against other industrialized nations, we have to develop a greater synergism among industry, public education, academia, and the Federal laboratories. Improving the efficiency of technology transfer is not only desirable, it could be critical to maintaining our national economic well-being.

POST-HEARING QUESTIONS FROM THE COMMITTEE ON SMALL BUSINESS

QUESTIONS SUBMITTED BY SENATOR DALE BUMPERS

QUESTION: Last fall before the Subcommittee on Regulation, Business Opportunities, and Energy, you testified that your office would prepare a "plan to optimize the technology in this country, its utilization and its relevance and contribution to our international competitiveness." You also noted that a draft of this "technology plan for the Nation" would be ready by early this year.

Could you please give the committee a progress report on the technology plan and a summary of its findings thus far? Also, what is your specific deadline for completing the report and how do you plan to use the report? Will President Bush review it as well?

ANSWER: The term "technology plan for the Nation" may have left the wrong impression about OSTP's activities in this area. We are currently engaged in two projects that deal with the Administration's approach to technology and industrial competitiveness. One is the preparation of a technology policy statement that will provide guidance on the appropriate Federal role in supporting technology efforts to concerned Federal agencies. The other is a report analyzing national critical technologies that will be submitted to the President and to Congress in October 1990. In combination, the results of these two studies will allow the Administration to assess the status of its current investments in R&D and undertake steps to optimize that investment.

QUESTION: Your testimony notes that one problem faced by your office is the lack of quantitative analysis on the progress in technology transfer since the passage of the 1986 Technology Transfer Act. It also states that OMB is working to improve reporting on these activities. However, it is my understanding that the federal agencies continue to participate in technology transfer activities, if at all, with varying degrees of interest.

Who in the Administration will be responsible for technology transfer policy among all of the federal agencies? Who will be the "hammer" you referred to last fall?

ANSWER: My staff is working closely with OMB, GAO, and other groups such as the National Academy of Sciences to improve agency reporting on technology transfer activities. The recent GAO survey, in particular, should give us a comprehensive picture of these activities and

provide standardized information about these activities. We expect to use the results of that survey to help determine what actions need to be taken to improve the effectiveness of the Federal Government's technology transfer programs.

I have recently established a Technology and Industry Committee under the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). The Committee is chaired by Deputy Secretary Thomas Murrin of the Commerce department. Its primary mission will be to examine at the Federal Government's technology policy including technology transfer from Federal Laboratories and also to address the issue of policy coordination and implementation.

QUESTION: You have stated that the Stevenson-Wydler Technology Innovation Act of 1980, the Federal Technology Transfer Act of 1986, and the National Competitiveness Technology Transfer Act of 1989 have given you the goals and necessary authority to promote commercial and public use of the science and technological resources of the federally operated laboratories. However, last fall you testified that the wording of the legislation was troublesome. In particular, you stated that the "precatory language" of the Federal technology Transfer Act was one reason why there was "no compelling force within the administration for unity." What has transpired to change our assessment of the necessary and proper legislative authority since last fall?

ANSWER: The reference to "precatory language" was not made by me but by Mr. Robert H. Brumley, who preceded me at the hearing last fall before the House Subcommittee on Regulation, Business Opportunities, and Energy (see page 7 of report Serial No. 101-31). My current position regarding necessary legislative authority is the same as it was when I testified last fall.

QUESTION: Does the Office of Science and Technology Policy plan to coordinate its technology transfer activities with officials at the Small Business Administration? How do you plan to ensure that small businesses will be involved?

ANSWER: The Office of Science and Technology Policy will work through the Technology and Industry FCCSET Committee (described in the my response to Question 2) to coordinate all Federal agency activities in technology transfer.

QUESTIONS SUBMITTED BY SENATOR GRASSLEY

QUESTION: What examples of ideal or model programs can you cite that link technology development and technology transfer to small business?

ANSWER: There has been a lot of activity in Federal technology transfer in recent years but in most cases, it is too early to tell which programs can serve as models. The Manufacturing Technology Centers program operated by NIST is one of these. The Small Business Innovative Research (SBIR) program has existed for sometime, and has generally received favorable reviews. Although SBIR is not purely a technology transfer program, there is embedded in it a technology transfer element that encourages small entrepreneurs to transfer a product or service developed for the government into the commercial marketplace.

It is my understanding that some of the states have exceptionally good programs. My staff is currently working to obtain descriptions of these programs to determine if they might be useful, or relevant, to the Federal sector.

QUESTION: What do you believe is the role of the Federal government in bridging the gap between Federal laboratories and technology-based small business development?

ANSWER: The Federal Government has a well-defined role, specified by the Federal Technology Transfer Act of 1986 as well as the legislation to assist small businesses in acquiring Federal laboratory technology. That role involves a variety of activities such as providing user facilities, technical advice, and opportunities for cooperative research and development ventures. In addition, companies can send their employees to some large Federal laboratories as guest researchers. The government now, perhaps, needs to make the services it offers more widely known to the small business community and to make them available with a minimal amount of bureaucratic impedance, that is, in a 'user friendly' way.

QUESTION: What specific programs are you proposing in fiscal year 1991 to initiate technology development and transfer for small business?

ANSWER: The Manufacturing Technology Centers program will be continued, at a request level of $5 million in FY 1991. The Advanced Technology Program has been proposed at a level of $10 million. In addition, all of the various Federal agency programs such as those conducted by the Department of Energy, National Aeronautics and Space Administration, and the Department of Defense are proposed for continuance. The evolving nature of all of these programs should ensure more, and more efficient, small business interactions.

QUESTIONS SUBMITTED BY SENATOR WALLOP

QUESTION: What role does your office play in bringing potential providers and potential users of technology transfer assistance together?

ANSWER: My office does not play a direct role in bringing providers and users of technology transfer assistance together. That function is more properly performed by the individual Federal agencies that have responsibility for technology transfer. However, my office is working to coordinate the policy and procedures that govern these activities.

QUESTION: Many people complain that there are too many steps involved in the technology transfer process and bureaucratic delays inhibit the development of new technologies. What recommendations could you make to remedy this situation?

ANSWER: I have recently established a Technology and Industry Committee under the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). That Committee will address the entire technology transfer issue, and, a review of current procedures will undoubtedly be part of its agenda. An analysis of the results of this review will enable policy makers as well as appropriate agency heads to take steps to streamline current procedures.

QUESTION: What technologies do you see emerging that would be beneficial to share with small manufacturers?

ANSWER: There are any number of such technologies and the need and use of them depends upon the part of the production cycle where the small business operates. A few illustrative examples will provide the framework for issues to be analysed in the coming months.

Small manufacturers frequently operate as suppliers of components to other companies which in turn perform final assembly. Thus, technologies that allow small firms to bring in computer-aided-design descriptions of the components, schedule production for just-in-time delivery, and guarantee quality for no-inspection receiving by the customer are of critical importance. These technologies include:

- **Standard data-descriptions, that are comprehensive enough to include tolerances, materials, and inspection requirements;**
- **Computer-assisted systems for preparing numerical control code from standard data files, or machine tool controllers that understand elements of standardized data-descriptions;**
- **Improved inspection systems, such as laser trackers, and easily programmed coordinate measuring machines, as well as, improved calibration methods for coordinate measuring machines and their internal algorithms;**
- **Advanced techniques for work scheduling and machine loading, tied to systems for routing work-in-process; and**
- **Integration of shop floor computer systems with associated business systems delivery such as estimation and inventory management.**

Most of this technology is also important for small manufacturers that produce end-user products instead of being component suppliers.

'Linking' technologies are also important to small businesses. Small manufacturers do not, in general, have the staff, financial, or time resources to develop and support advanced manufacturing systems based on laboratory-level technology. Instead, they need to be able to purchase components which are commercially available and commercially

supported. They can then integrate then into manufacturing systems that meet their needs. Examples of 'linking' technologies include:

- o Advanced networking and standard network interfaces;
- o Standard control architectures with well-defined, comprehensive standard interfaces; and
- o Standards for user interfaces;

In some cases, the transfer to small firms must be through vendors who package and support complete devices or systems. Examples of these technologies include:

- o Sensors to be used for observing and controlling manufacturing processes, including sensors for surface finish, tool condition (dull, broken), chip form, position in space, quality of solder joint, and many more;
- o Controllers for machine tools, robots, and material handling systems, as well as for coordinated interactions among such devices (so-called workstation, cell, and shop controllers);
- o Software systems for computer-aided design, engineering, and manufacturing process planning; generation machining and inspection control instructions from computer-based designs; and creation of routing and material handling control instructions from process plans and machine loading data; and
- o Intelligent robots with well-defined, rich, and standard interfaces suitable for use in manufacturing environments.

STATEMENT OF HON. RUDY BOSCHWITZ, A U.S. SENATOR FROM THE STATE OF MINNESOTA

Senator BOSCHWITZ. It is unfortunate that such a small percentage of Federal research is being commercialized. I do agree that large companies are far more capable of taking advantage of Federal research. They have the facilities for doing so. Small companies, which are the focus of today's hearing, are less well equipped to do so. As you point out, it is damn frustrating for small businesses, or individuals for that matter, to try to cope with the Federal Government and the bureaucratic structure. As you say, their phone calls are shot from one part of the Government to the other.

I do not know if you are going to be able to stay for the balance of the morning. You may not be able to, and I am not familiar with each one of the witnesses who are going to come before us. I am familiar with Mr. Joseph Shuster. He is from my State of Minnesota, president of Teltech, and recognizing the difficulty that small businesses have in finding expertise, he has catalogued and computerized a nationwide bank of expertise.

If you call Mr. Shuster's company with a specific problem he would be able to tell you who the leading experts are in the country. Small businesses would be able to cut through the redtape and gain the ability of finding expertise in areas that would otherwise be unavailable to them.

It is my hope that he will also devise a system providing ability to reach into the research done by the Federal Government. If you are not staying, I would ask that, as you leave, Mr. Shuster make himself known to you. You two can go outside and chat for just a minute I believe so that you can get a sense of what he is doing.

You have touched on many of the problems I would have. I liked your remarks about the scandal of education. I do not know exactly what to do about all of those problems I must tell you.

I know my father used to think that my education was rather lax compared to his. Of course, he was educated in Europe and took 8 years of Latin. When we came to the United States, he began to talk English rather readily, albeit with quite a heavy accent, because of his background in Latin. He always bemoaned the fact that I only took 2 years of Latin, and that some of the basics of education seemed to have disappeared from the scene. Less than excellence is seemingly satisfactory, which is unfortunate.

I appreciate your testimony. I do also appreciate the fact that you are going to seek, with Mr. Phillips or with somebody else at the White House under your jurisdiction, to try to grease the skids and make technology more available to small business.

That is why I think Mr. Shuster might be of some help to you and why I asked if you would please talk to him on the way out.

It is a worthwhile thing that we are trying to do here. As you point out, small businesses are innovative almost by design and definition. Having been a small businessman and something of an innovator, I like to think that way perhaps, but I do believe it is the truth.

I thank you for your testimony which I found very illuminating and very excellent.

[The prepared statement of Senator Boschwitz follows:]

STATEMENT OF SENATOR RUDY BOSCHWITZ

TECHNOLOGY TRANSFER

THANK YOU, MR. CHAIRMAN. I WOULD LIKE TO COMMEND YOU FOR HOLDING THIS HEARING ON TECHNOLOGY TRANSFER WHICH, I BELIEVE, IS VERY IMPORTANT TO SMALL BUSINESS.

TECHNOLOGY TRANSFER IS A COMPETITIVENESS ISSUE. THE GOAL OF THE FEDERAL TECHNOLOGY TRANSFER PROGRAM IS TO IMPROVE THE COMPETITIVENESS OF U.S. COMPANIES. BUT THE CURRENT SYSTEM IS NOT WORKING AS IT SHOULD. THERE ARE SEVERAL HUNDRED FEDERAL LABORATORIES IN THIS COUNTRY WHICH SPEND MORE THAN $60 BILLION PER YEAR ON RESEARCH. UNFORTUNATELY, A VERY SMALL PERCENTAGE OF FEDERAL RESEARCH IS BEING COMMERCIALIZED. AND THE VAST MAJORITY OF BUSINESSES DO NOT UNDERSTAND THE FEDERAL TECHNOLOGY TRANSFER SYSTEM AS IT CURRENTLY EXISTS.

THERE APPEAR TO BE MANY OBSTACLES TO THE COMMERCIALIZATION OF TECHNOLOGY FROM FEDERAL LABORATORIES. LARGE AND SMALL AMERICAN BUSINESSES FIND IT EXTREMELY DIFFICULT TO IDENTIFY, ACQUIRE AND PROPERLY USE NEW TECHNOLOGIES DEVELOPED BY FEDERAL LABS.

SOME SAY THE FEDERAL LABS DO NOT UNDERSTAND THE PRIORITIES AND PRESSURES OF THE BUSINESS WORLD. THIS CONTENTION, ALONG WITH THE FRUSTRATIONS THAT COME WITH DEALING WITH THE FEDERAL BUREAUCRACY, CAUSE SMALL BUSINESSES TO LOSE INTEREST IN WORKING WITH FEDERAL LABS.

THE FEDERAL TECHNOLOGY TRANSFER ACT (FTTA) OF 1986 WAS DESIGNED TO PROVIDE A BRIDGE BETWEEN RESEARCH PERFORMED AT FEDERAL LABS AND THE PRIVATE SECTOR. FTTA AUTHORIZED THE FEDERAL LAB DIRECTORS TO ENTER INTO COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADA) WITH PRIVATE FIRMS. IT ALSO PERMITS FEDERAL INVENTORS TO BE REWARDED WITH AT LEAST 15% OF ANY ROYALTIES RECEIVED BY THE LAB FROM THE INVENTION. THE FTTA AND CRADA'S HAVE CERTAINLY HELPED IMPROVE THE TECHNOLOGY TRANSFER SYSTEM, AND I KNOW THERE HAVE BEEN SUCCESS STORIES; HOWEVER, WE STILL HAVE A LONG WAY TO GO TO PERFECT THE SYSTEM.

PUBLIC LAW 100-418, THE OMNIBUS TRADE AND COMPETITIVENESS ACT, ESTABLISHED THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) -- FORMERLY THE NATIONAL BUREAU OF STANDARDS. THE LAW MANDATES THAT NIST ESTABLISH REGIONAL CENTERS FOR THE TRANSFER OF MANUFACTURING TECHNOLOGY. THERE ARE CURRENTLY THREE CENTERS OPERATIONAL -- CLEVELAND, OHIO; TROY, NEW YORK AND COLUMBIA, SOUTH CAROLINA. THESE CENTERS PROVIDE FOR THE TRANSFER OF TECHNOLOGY DEVELOPED BY NIST TO SMALL AND MEDIUM-SIZED FIRMS.

AS I UNDERSTAND IT, THERE ARE SOME LEGAL AND REGULATORY ISSUES -- SUCH AS LEGAL LIABILITY, OWNERSHIP OF INTELLECTUAL PROPERTY RIGHTS, AND ACCESS TO FACILITIES -- WHICH COULD CAUSE A DIRECTOR OF A FEDERAL LAB TO IGNORE TECHNOLOGY TRANSFER. THESE DIRECTORS MUST BE MADE AWARE THAT TECHNOLOGY TRANSFER IS A PRIORITY.

I BELIEVE ONE AGENCY NEEDS TO BE CHOSEN TO COORDINATE THE TRANSFER OF FEDERAL TECHNOLOGY TO THE PRIVATE SECTOR. PERHAPS IT SHOULD BE COMMERCE -- PERHAPS SBA. THERE NEEDS TO BE AN ADVOCATE IN THE ADMINISTRATION TO PROVIDE OVERSIGHT FOR FEDERAL TECHNOLOGY TRANSFER POLICY. THAT AGENCY MUST ALSO CONDUCT A FORMAL INVENTORY OF FEDERAL LABORATORY RESOURCES. AT THIS POINT FEDERAL TECHNOLOGY TRANSFER EFFORTS APPEAR TO BE UNDERSTAFFED, UNDERDIRECTED AND ONLY MARGINALLY FOCUSED.

A BUSINESSMAN FROM MY STATE OF MINNESOTA WILL BE TESTIFYING TODAY ON THE NEED FOR A NATIONWIDE DATA-BASE SYSTEM CONTAINING FEDERAL RESEARCH WHICH CAN BE ACCESSED BY THE PRIVATE SECTOR. SUCH A SYSTEM WOULD BE BACKED UP WITH THE EXPERTISE OF THE LEADING SCIENTISTS AND ENGINEERS IN THE COUNTRY. I BELIEVE THIS IS AN EXCELLENT IDEA AND COULD PROVE MOST HELPFUL TO SMALL BUSINESS. I WANT TO PURSUE THIS IDEA FURTHER WITH MR. SHUSTER TODAY.

HOW DO WE CUT THROUGH THE RED TAPE? HOW DO WE STREAMLINE THE SYSTEM? HOW DO WE MAKE IT UNDERSTOOD? HOW DO WE PROTECT THE DISCOVERIES OF FEDERAL SCIENTISTS PRIOR TO THE APPROVAL OF A PATENT? I HOPE TO GET ANSWERS TO THESE AND OTHER QUESTIONS THIS MORNING.

I WELCOME OUR DISTINGUISHED GROUP OF WITNESSES, INCLUDING OUR COLLEAGUES, SENATOR ROCKEFELLER AND CONGRESSMAN WYDEN. I THANK YOU, MR. CHAIRMAN, FOR HOLDING THIS HEARING ON A MATTER OF GREAT IMPORTANCE TO SMALL BUSINESS.

Senator BOSCHWITZ. Senator Wallop.

Senator WALLOP. Dr. Bromley, I found myself intrigued by several of the observations you made, one of which, that Technology Transfer is an awkward phrase. Unfortunately, we adopted it a little more than a decade ago and so we seem stuck with it, but it really is the question of utilization.

How do we—now, I will start by guessing that we have—782?

Dr. BROMLEY. Seven hundred twenty six.

Senator WALLOP. Seven hundred twenty six labs. How does the country make it part of their mission, as you suggest, to get this information into the world of utilization?

Dr. BROMLEY. I think there are several stages, Senator. First of all, I think that it has to come direct. These laboratories, of course, are within the various agencies of Government, the Defense Department, the Department of Energy, Health and Human Services and so on. I think that we have to start right at the top.

Senator BOSCHWITZ. It does not include universities?

Dr. BROMLEY. That number does not include universities, no. That is simply the Federal labs.

Where it must begin is with the leaders of those agencies, with the Cabinet Secretaries and with the agency heads, making it very clear that this is a high priority of that agency. That then goes down to the laboratory director.

I think the laboratory director has to keep emphasizing in his laboratory wide talks and his interactions with his senior deputies and, in particular, in the structure of reward that is set up in those laboratories.

Senator WALLOP. That was going to be my second question, so why don't you wrap them together. How do we make that flexibility and reward structure?

Dr. BROMLEY. It seems to me that there are two ways. The Phoenicians were the ones who long ago invented one of the most effective motivating tools—money. And so, I think that if we keep that one firmly in mind, each year as the salaries are adjusted, one should keep in mind what has individual X done to really move forward this important mission of our laboratory.

The second thing, of course, has to do with promotion, psychic rewards. Here again, in the past in most national laboratories, salary, promotion, everything else has been keyed specifically to research accomplishment. And as a matter of fact, Senator, I would add something else. In this country, I think one of our problems is that our reward structure has not only focused specifically on the research, but it has focused on the Nobel Prize-type research that will make revolutionary differences, that will start totally new industries, and that is great. We need that. But what we have forgotten, and what our competitors in Europe and in Japan have not forgotten, is the evolutionary research that allows you to take a product to market a little faster, a little cheaper, a little more reliably and allows you to pick up market share on a continuing basis.

We have to change our reward structure to recognize the evolutionary discovery much more than we do now, so I would have two aspects. I think that in our laboratories we have to instruct the laboratory directors that as they examine their staff and consider them for whatever rewards are available, they keep in mind that

in addition to doing the Nobel-type research, there is also a very important area, particularly when they deal with industry: telling industry and helping industry to get market share in an international marketplace. And, second, working on that transfer with and to industry.

Senator WALLOP. Just briefly, should we contemplate some means of transferring a proportion of interest to those who have worked on this?

Dr. BROMLEY. We have such structures in place now, sir, and I do not think that a specific amount is all that important. The actual principle that the developer does share in the rewards is important, and it is in place.

Senator WALLOP. So, you think promotion ought to be on something more than longevity?

Dr. BROMLEY. Indeed I do. Indeed I do, sir.

Senator WALLOP. Let me just observe that when the GAO conducts a study, it is my fervent hope that they drop their new-found habit of partisanship and go back to their old professionalism of impartiality. That way, we and the country will get something out of the money that we have spent on it.

Let me last ask you, just very quickly, do you have any theories as to why the interest drops, in which you expressed alarm, have occurred?

Dr. BROMLEY. Indeed I do, sir. The problem is one of long standing. It is a problem that in part, we have ignored for far too long in this country. It is simply the fact that in mathematics, science, and engineering, career decisions, in contrast to almost all other professions, are made much earlier in the educational process. Most engineers and scientists, mathematicians, have decided by the junior year in high school, what their career path will be. If we have lost them there, we have lost them totally.

But it is worst than that. Our quality of education in the average high school in this country is such, first of all, that it does not attract youngsters into these fields, and for those who manage, despite the quality of the education that they have received, to still retain an interest, their education does not provide them with the background that would enable them to really be successful in the first critical years when they have to decide, can I hack this, can I really make a career out of this, or will I throw in the towel and go become a lawyer. And a great many of them do that.

Senator WALLOP. Well, you will not find much quarrel from the two at the desk today.

I am done. Thank you, Mr. Chairman. Thank you, Dr. Bromley.

Senator BOSCHWITZ. Dr. Bromley, it is my understanding that Federal labs must spend half a percent of its R&D budget on Technology Transfer. Is it possible that some of that money could be used as a central clearinghouse for a database system? Is that a sensible approach to the problem?

Dr. BROMLEY. Yes, I think it is, sir, and I welcome the initiative that your constituent has taken. I think that if we could, for example, see how a Pilot Program might work in your state, it could be a very important input to discussions that we are having in my office right now about the establishment of national databases in these areas.

Senator BOSCHWITZ. Thank you, Dr. Bromley. Why don't I say to Mr. Shuster: Make yourself known to Dr. Bromley as he leaves here. Thank you very much.

And now we will have the second panel, Mr. Lee Mercer, Don Johnson, Dr. Philip Chen and Ms. Tina McKinley.

OK, we are going to start with Mr. Mercer, the Acting Undersecretary of Technology at the Department of Commerce. Did you submit testimony?

STATEMENT OF LEE W. MERCER, DEPUTY UNDERSECRETARY FOR TECHNOLOGY, U.S. DEPARTMENT OF COMMERCE, ACCOMPANIED BY DON JOHNSON, DIRECTOR OF TECHNICAL SERVICES, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MD

Mr. MERCER. Yes, we have submitted testimony.

Senator BOSCHWITZ. Mr. Mercer, we are going to ask you to summarize your statement, and we will have a timer that gives you an indication of how long you can go.

Mr. MERCER. Mr. Chairman, thank you, and Senator Wallop. It is an honor for me to be back here.

I spent 4 years from 1981 to 1984 as Senator Rudman's legislative staff director and counsel, and spent many happy days in the Committee rooms here. Prior to that, I had worked 10 years as a lawyer representing small businesses in New Hampshire. And for the last 4 years, I have been in the Commerce Department, working first in high-technology export controls—much of that work involved small businesses—and now as Deputy Under Secretary of Commerce for Technology.

I am going to summarize my testimony and some of things I may touch on are not in this testimony. I would like to start by making the observation that the U.S. Government funds 50 percent of all R&D and 80 percent of the basic research. It employs ⅙ of the scientists and engineers in this country. The United States has 5.5 million scientists and engineers, double the number in Japan, for instance. We win more Nobel Prizes than the rest of the world combined.

Of interest to this Committee is the fact that I have tried to find out how many high-technology firms there are in the United States. If you define them as firms that employ at least one person full time on R&D, there is estimated to be 30,000 to 40,000 such firms, 85 percent of which are small businesses.

Yet, as this Committee knows only too well, technology has no value unless somebody is using it. And that is critically important to our country. Most economists agree that 50 to 60 percent of all economic growth is due to technological innovation.

If we learn anything from the Japanese, it is that the limits on growth are not a function of limits on resources or technology. In the past decade, we have had more resources applied in these areas and more technology available in this country. I quote from the 1988 findings by the Council on Competitiveness, "U.S. public officials, and hence, the United States, assumed that preeminence in science automatically confers technological and commercial suc-

cess. It does not. America assumed that Government support for science would be adequate to provide for technology. It is not."

This is not a new truth. Back in 1966, Robert Stern, the Program Director of the Commerce Department's Symposium on Technology and World Trade said, "Technology does not automatically flow to where it is needed. It is necessary that men spend their wills and their hearts to bring technology to people in a way that will contribute to their progress, their health, and their well being."

With that background and with the need for innovation and for Technology Transfer, as this Committee knows, the question is who does it best. And of course, the answer has always been small business.

In the 20th century, one study indicated that of 61 important inventions in the century, 50 percent were from small companies. In the steel, aluminum, and petroleum industries, of 27 important break-throughs, only one came from a major U.S. company.

In a study that was based on the years 1953 to 1973, small firms produced 24 times as many major innovations per R&D dollar as large firms. And we should remember that, for instance, Digital Equipment Corp. was started in 1957 by three people. It is now second only to IBM with 115,000 employees. Other examples are Cray, Apple, Sun Microsystems, Xerox.

Now, the question with regard to Technology Transfer, I suppose, is—as Oliver Wendell Holmes said, "The real question is in which direction are we heading? Are we making progress?" Well, in a sense, things are getting better. I think, as you have heard previous witnesses testify, that the problems that we face today are more attitudinal than they are legal. The laws that were passed in 1980, 1982, 1984, 1986, 1989 have taken care of a number of the legal problems.

We have come a long way since President Johnson's study of HHS found that not one drug had ever been commercialized when the Government owned the patent. And in the late 1970s, it was found that the Government had stock piled over 28,000 patents, licensing just 5 percent for development.

The Bayh-Dole Act of 1980 has changed some of that. The patents issued to universities total 230 for the year 1975. In 1989, the number had grown to 1,145. University revenues from patents are up substantially as well. In the Federal Government, revenues are up as well, also. NTIS reports a quadrupling of Federal royalties between 1985 and 1988 to $5.6 million in 1988.

Cooperative research and development agreements, which stood at 100 agreements in place in January 1989, now number 350, with more pending, many more pending. A 250 percent increase in a little over a year. In other words, we are heading in the right direction.

The SBIR Program, of which Senator Rudman was the primary sponsor back in 1981, has now invested over $2 billion. The GAO has found that SBIR projects are more likely than any other research to lead to inventing and commercializing new products. Again, the use of small business.

And if you look at a 4-year period at NSF during which $28 million was invested in the SBIR Program you will find that the re-

cipients were successful in attracting $266 million in follow-on capital for a positive leverage figure of nine to one.

One of the problems with regard to the SBIR Program, as I think the Senator may recall, is when we put that law into effect, the percentage of money going to small businesses was 3.5 percent of the R&D funds in this country, and we had hoped, by raising up 1 percent, to increase that amount. Now we find that the percentage is actually lower than it was in 1981, although, in dollar terms, obviously higher. So, funding problems still exists.

But we are headed in the right direction, and we can do more. One goal of the Technology Administration is to close the information gap that you have heard about between small businesses and our Federal lab systems. For instance, NTIS publishes this book. This is the 1989 edition. This has in it over 1,000 Federal patents that are available for licensing to any businesses who want to come in and license them.

Now, many people do not know this book exists, but here is a resource, 1,000 patents, over 1,000 patents that are available for licensing. We can do more. We will be using the State Technology Extension Program to address that information gap. We will use the State and Local Clearinghouse as well. We will be involved in training. We hope to produce a training film for Federal laboratory managers. In addition, the Commerce Department chairs the interagency group on Technology Transfer.

The fact is, as you have heard, that Technology Transfer is a contact sport. It takes people-to-people work to get the job done. We look forward to exchanging views with this Committee and to working with you to identify more innovative ways that we can get the job done.

Thank you very much.

[The prepared statement of Mr. Mercer follows:]

STATEMENT OF LEE W. MERCER

DEPUTY UNDERSECRETARY FOR TECHNOLOGY

BEFORE THE SENATE COMMITTEE ON SMALL BUSINESS

MARCH 8, 1990

28-858 0 - 90 - 3

Thank you for this opportunity to testify before the Committee on an issue which is very important to the Department of Commerce-- increasing the commercialization of federally-funded research by United States industry-- particularly small businesses.

The U.S. Government funds approximately one-half of all our R&D, supports about 80% of U.S. basic research and employs one-sixth of our scientists and engineers. We must translate this investment of the American taxpayer into new products, jobs, and business opportunities if we are to remain competitive in an increasingly tough international economy.

We have made enormous strides foward in the last ten years. This is not to say that all barriers have been overcome. Nevertheless, we have removed the main legal obstacles preventing joint R&D efforts between our federal laboratories, universities and the private sector. The public sector is becoming increasingly skillful in applying new authorities allowing our universities and federal laboratories to manage their technologies. One of the most heartening developments from this effort is the formation of small, high technology spinoff companies from our universities. I believe that we will see a similar trend around our federal laboratories now that they can manage their technologies on a decentralized basis.

By removing old legal barriers between our public and private sectors, U.S. industry can now draw from the world's largest research pool. Industry can tap into long-range, high risk research using unique facilities which took billions of dollars

to establish and which are impossible for the private sector to replicate. This ability is increasingly important as our companies operate in today's complex and competitive world markets. Once again we find small companies are playing a crucial role in translating the public's investment into new jobs and products.

As Secretary Mosbacher stated in his recent report to the President and Congress on the implementation of the Federal Technology Transfer Act, in order to judge how far we have come, we must remember where we started. After World War II the basic policy toward all Government funded R&D was essentially a Marshall Plan for technology. Any patentable or commercially valuable discoveries made with federal funding were freely available to anyone who chose to exploit them -- domestic or foreign. A particular threat to small businesses seeking a Government R&D contract was the fear that they would be required to turn over to the Government their previously existing technology-- termed background rights-- in order to receive federal funding. This posed a dire threat to companies seeking to compete with larger businesses on the basis of leading technical positions.

The policy of non-exclusively licensing patent rights resulting from federally supported R&D, the lack of incentives for the public sector institutions to pursue commercially important research, and threats felt by small businesses if they worked for the Government, led to a widening gap between the U.S. public and private sectors.

Ignoring the observation of President Lincoln that the patent system was designed to "add the fuel of interest to the fires of genius," few incentives were available to reward our federal scientists or their laboratories for successful technology transfers. The result was predictable.

President Johnson's Administration conducted a study of the Department of Health, Education and Welfare (now HHS) in 1968 and found that not one drug had ever been commercialized when the Government owned the patent. A decade later the situation had not improved. By the late 1970's the U.S. Government had stockpiled over 28,000 patents on its shelves and was licensing less than 5% of them for development. It routinely took up to 3 years for universities to receive final answers on their petitions to Washington for ownership of the inventions they made with federal support.

Recognizing that a new approach was needed in a hurry, Congress tried a revolutionary approach-- allowing for decentralized technology management coupled with incentives for success. Passage of the Bayh-Dole Act in 1980 (P.L. 96-517, as amended) for universities and small business contractors, and the Federal Technology Transfer Act in 1986 (P.L. 99-502) for federally owned and operated laboratories, were clear breaks with the past. President Reagan in Executive Order 12591 in April, 1987 made these laws the centerpieces of the Administration's technology management policy.

I should add that this Committee was a central player in the passage of the 1980 law as well as the initial platform for

the launching of the highly successful, agency-wide Small Business Innovation Research Program (SBIR). Both laws are heartening examples of successful Government-industry partnerships, both in the policy implementation stage and in successful program follow-through.

The first indicator of the impact of the Bayh-Dole Act was a jump in the number of patents issued to universities after years of stagnation. The University of Minnesota, in its annual survey of university patenting trends, reports an almost 500% increase from 1978 to 1989, when universities received 1,145 patents. The base had been approximately 250 in 1978.

We have already seen significant economic benefits from the new policies. The U.S. biotechnology industry was greatly assisted because universities were allowed to manage their technologies without interference from Washington. This permitted the creation of a series of small biotechnology spin-off companies around our major universities.

The University of Utah is a leader in medical device technology having created more than 35 small high-tech businesses in the last 8 years. This is of interest especially because these success stories are not located in Silicon Valley, the Route 128 area near Boston, or the Research Triangle in North Carolina, areas traditionally thought of with respect to the creation of small high-tech businesses. All states and local governments are increasingly citing their universities as centers of their economic development plans. Federal laboratories only add to the effort.

We are just now beginning to see economic growth centering around federal laboratories. An interesting example is the incubator park that has been created in Ames, Iowa to take advantage of the Department of Energy laboratory in Ames at Iowa State University. To date, nine small firms have been started.

A number of Department of Energy contractor-operated laboratories have compiled impressive small business successes since Congress gave them the ability to manage their technologies in 1984. Besides Ames, Argonne Naticnal Laboratory in Illinois is already spinning off start-up companies. The University of Chicago, the contractor operating Argonne, is even forming its own venture capital fund to assist this effort. Oak Ridge National Laboratory in Tennessee licenses about one-third of its patent portfolio to small businesses, while also performing one-third of its ccoperative agreements in the superconductivity pilot center with small companies. Pacific Northwest Laboratory in Washington State has licensed a number of inventions to small companies which are successfully marketing them. With the enactment of the National Competitiveness Technology Transfer Act of 1989, recently signed into law by President Bush, the Department of Energy's laboratories will be able to work even more closely with U.S. businesses, including small businesses.

This experience is important to the rest of Government; it shows that success can be had using the current laws. The Federal Technology Transfer Act in 1986 gave Government-owned and operated laboratories technology management authorities similar

to those given universities in 1980 and university-operated federal laboratories in 1984.

The federally owned and operated laboratories are now showing results strikingly similar to those shown by universities in the early 1980's. The Department of Commerce has already seen its patent applications triple since enactment of the Federal Technology Transfer Act. The Department of Agriculture reported 76 inventions in FY 1987 and 139 in FY 1988. The Army's inventions disclosures increased 40% and the Navy's 30% during the last year. Health and Human Services reported that as many inventions were disclosed during the first nine months of 1988 as in all of 1987.

The National Technical Information Service reported a quadrupling of federal royalty income between FY 1985 and FY 1988 when royalties reached $5.6 million. While modest compared to current university royalties, this growth is indicative of the excitement caused by the Federal Technology Transfer Act, and we expect continued growth each year.

There has already been considerable success in using the Act. Secretary Mosbacher cited more than 100 cooperative research and development agreements (CRADA's) already signed in the first two years of the law.

This number has steadily increased since the report was written. There are now approximately 350 agreements in effect, and many more pending.

The Commerce Department's National Institute of Standards and Technology (NIST) has been a leader in implementing the Act, and

is completing approximately four agreements a month. I am happy to add that fully 40% of these agreements are with small companies.

NIST and its close neighbor the National Institutes of Health are rapidly forming close relationships with many of the small high technology companies forming along with I-270 corridor in Maryland. Industries, government agencies, and educational institutions in Montgomery County are certainly aware of the potential economic benefits from such arrangements and have formed a network to promote regular biotechnology meetings among the laboratories and industry which are well attended. This type of regular interaction between federal laboratories and small businesses is a high priority of the Department of Commerce which is charged with assisting all agencies in fully implementing the new technology transfer authorities.

One of the goals of the Department of Commerce's new Technology Administration is to close the information gap between small businesses and our federal laboratory system. The problem is the difficulty that federal laboratories and small businesses have in finding each other. We have a number of projects underway to help alleviate this situation. I do not mean to imply that this is a simple problem, however.

Both federal laboratories and small businesses have very limited resources for seeking out potential partners. This is an area where state and local governments must provide the critical link.

The Department is using the Boehlert/Rockefeller State Technology Extension Program and the Clearinghouse for State and

Local Initiatives on Productivity, Technology, and Innovation -- both of which were established in the 1988 Omnibus Trade and Competitiveness Act-- to help form this linkage.

Under the Boehlert/Rockefeller program, the Department's Technology Administration will expand its traditional technology transfer effort-- particularly by focusing on small businesses. There will be a number of conferences with state extension agents to familiarize them with resources such as NIST's Regional Centers for the Transfer of Manufacturing Technology (bringing modern automated manufacturing to small and medium sized companies) (the MTC program), the Research Associate and Visiting Scientist programs (where industry scientists can train at NIST), the Proprietary Research Program (where NIST facilities can be leased for private research), and the (Small Business Innovative Research Program) among other NIST services. The President's FY 1991 budget requests $5 million to support the MTC program as an additional way to provide technological assistance to small and medium sized businesses.

The Boehlert/Rockefeller program received a $1.3 million appropriation for fiscal 1990. Of this amount, approximately $900,000 is available to support cooperative agreements to demonstrate methods by which states can increase the use of federal technology by businesses. The remainder is to be used in preparing materials, workshops, and technical evaluation programs to assist states in technology assistance programs. The Department will place special emphasis on serving the needs of small and medium sized companies in these efforts. No funds are

requested in the President's 1991 budget for this program. We expect that strong Federal-state technology transfer arrangements will continue as a result of the relationships established between the Technology Administration and the states, in 1990, and the activities of the clearinghouse for State and local initiatives, as I am about to describe.

The Clearinghouse for State and Local Initiatives will fill three needs; a repository of federal, state and local initiatives to improve competitiveness; a network for exchanging successful models for technology transfer and other information; and an analytical unit which, upon request, can help state and local governments evaluate methods for boosting economic growth and diversity.

An example of the potential of the Clearinghouse in assisting technology transfer occurred last month. The Interagency Committee on Federal Technology Transfer, which Commerce chairs, met on February 16, 1990 to discuss increasing technology transfer to small businesses. The point was made that many small companies need financial assistance in order to commercialize federally-supported technology, and that many laboratories are at a loss where to direct these companies for help. The Clearinghouse is developing a list of public and private venture capital funds, lending authorities, or related product development and financial assistance groups that help fill this gap. The list will be given to all Committee members

for distribution to their laboratories. In addition, the Clearinghouse stands ready to link technology managers with business assistance sources. Previously, such information was only available on a piecemeal basis. Although not publicized as "open for business," the Clearinghouse is operational and giving assistance to callers.

The Clearinghouse will also be a key part of the Technology Administration's active outreach program to the states and the private sector. We plan on conducting a number of regional workshops and conferences to alert companies to the new opportunities for working with the federal laboratories and universities. States can use the resources of the Clearinghouse in cooperation with NIST, to help access the resources of the federal laboratory system.

The Committee also was briefed on the resources of the Energy Related Inventions Program which NIST runs in conjunction with the Department of Energy. The program evaluates more than 1,000 small business ideas per year for new energy-related products and processes. During the course of this program an extensive small business data base has been developed which could be very useful in identifying potential small business partners for joint R&D.

This network can also serve to alert small businesses where laboratories are conducting R&D of interest to them. To be

successful, technology transfer must be a pull from the private sector, not a push from Government. We are working hard to help industry identify on-going federal R&D which they can move into the market.

In summary, we have made considerable progress in breaking down the formidable barriers which had grown up over forty years among universities, federal laboratories and American industry. Agencies are taking this responsibility seriously. The Department of Commerce sees its role as a facilitator of this effort.

We will see increased economic competition in the years ahead. Japan is undertaking an intensive effort to overtake our lead in basic research, particularly in commercially important areas like biotechnology. A united Germany can only be a stronger competitor. We do not need to flinch from this challenge. We have everything we need to compete if we choose to use our economic and scientific resources to the best advantage. Linking our public and private sectors in joint R&D projects, and particularly facilitating the participation of small business in these projects, is one of our most promising strategies for long term success. This is also an area where the Administration and Congress have worked in close cooperation. The results in just ten short years have been impressive.

QUESTIONS FROM SEN. BUMPERS
FOR DEPUTY UNDER SECRETARY LEE W. MERCER

1. I am interested in receiving an update on the Clearinghouse for State and Local Initiatives on Productivity, Technology and Innovation. Have you met with NIST officials and the National Governors Association on this issue?

A. We have met regularly with NGA, NIST and other appropriate organizations on how to design the Clearinghouse so that it best meets the needs of its intended beneficiaries. We have enlisted the assistance of the U.S. Advisory Commission on Intergovernmental Relations in designing an appropriate scope and role for the Clearinghouse and in developing a plan for implementing the design. At this time, we expect the Clearinghouse to serve as (a) a repository of "who is doing what" to enhance competitiveness, (b) a network through which those who provide information and assistance to business can share resources and experiences, and (c) an analytical institution that can examine and assess the variety and effectiveness of the many different kinds of state and local initiatives.

2. It is my understanding that there has been some discussion about moving the Boehlert-Rockefeller Technology Transfer Extension Program from the National Institute of Standards and Technology to the Commerce Department. Are there any plans to reorganize the administration of this program? This would require a legislative change, would it not?

A. Discussions of this type always take place. I have consistently tried to maintain an atmosphere within the Technology Administration in which the different components are encouraged to discuss alternate organizational arrangements for discharging our responsibilities. In this case, recognizing that the NIST budget request for FY 91 would contain no funds for the program and that the Assistant Secretary for Technology Policy's Clearinghouse (see Question 1) was also aimed at serving the states, I asked the two components to develop and consider various options. The organic legislation authorizes the Secretary to act "through the Director and, if appropriate, through other officials." However, we have made no decisions about organizational rearrangements and I would expect that the proper Committees will be consulted if we conclude that any major changes are warranted.

3. How will the grant evaluation guidelines under the Technology Transfer Extension Program ensure that unfair advantage will not be given to larger, wealthier states that have ongoing programs?

A. The legislation requires that the evaluation of each state application include consideration of "the extent to which the

state extension service will demonstrate new methods" (emphasis added). By applying the term "new methods" to each state, no advantage should be given to wealthier states with on-going programs. However, the legislation also requires a state commitment to spend an amount equal to the federal assistance. We consider it important to leverage funds to the maximum extent practical. Accordingly, we have included a requirement in the evaluation criteria that consideration be given to the total dollar amount committed by each applicant.

QUESTIONS FROM SEN. WALLOP
FOR DEPUTY UNDER SECRETARY LEE W. MERCER

1. Why has so little attention been given to technology transfer assistance for non-energy inventions?

A. With the $150,000 appropriated for the design and development of a non-energy related inventions program over the past two years, we have concentrated on stimulating state innovation programs to develop seed capital mechanisms to support inventions, and on exploring the possibility of NIST providing a centralized non-energy related invention evaluation service supporting seed capital investments at the state level. Mr. George Lewett, Director of the Energy-Related Inventions Project at NIST, has initiated several small scale demonstration projects with SBA Development Centers in several states in an effort to demonstrate the potential benefits to the states. Wyoming was among the participants in the first pilot effort and Wyoming's program, led by SBDC Director Mac Bryant was among four chosen to be models for neighboring states in this year's extension of the pilot effort.

2. If we are to be competitive with Japan and other countries in the Pacific Rim, shouldn't we broaden our efforts to develop other high technology inventions?

A. There is no question as to the importance of stimulating the development of high technology inventions and we share your view as to the importance of small, innovative high tech firms. We hope small, tech firms play a positive role in the soon to be implemented Advanced Technology Program.

3. A representative from NIST recently visited several small manufacturers in Casper, Wyoming, most of which make non-energy related products. The purpose of this visit was to provide some impetus for funding the non-energy related inventions program and arrange a future workshop for these businesses. However, since your resources for this type of project seem limited for FY 90 and have been eliminated for FY 91, what other avenues do these businesses have for assistance with product innovation through technology transfer?

A. Mr. Lewett, who is responsible for initiating the non-energy invention program (see Question 10), has visited Wyoming recently and I understand that he discussed the prospect of having Wyoming take the lead in forming a consortium of states which could provide appropriate resources to enable him to evaluate non-energy inventions in those jurisdictions. Mr. Lewett has advised us that he hopes that Wyoming will be able to assume such a leadership role in demonstrating the benefits of a Federal-State partnership of this nature. We also understand that some of the

energy inventions in those jurisdictions. Mr. Lewett has advised us that he hopes that Wyoming will be able to assume such a leadership role in demonstrating the benefits of a Federal-State partnership of this nature. We also understand that some of the technologies discussed might fit within the scope of DOE's existing energy-related invention program.

4. Whose function do you perceive it to be to create a demand for technology transfer assistance?

A. The state and local programs which work closely with the customers are in the best position to provide direct services and to create the demand for technology transfer assistance. Concerted outreach and marketing at the state level has the greatest potential. The federal role is to support and facilitate the states and help them coordinate their efforts.

QUESTIONS FROM SEN. GRASSLEY
FOR DEPUTY UNDER SECRETARY LEE W. MERCER

1. What examples of technology-stimulated, new small business developments that were grown out of Federally funded research can you cite?

A. There are several.

- DOE has reported that since 1985 more than one hundred new companies were created as a result of technology developed in its laboratories. Argonne National Laboratory, near Chicago, has been particularly active. Examples include American Ceramic Engine, which is marketing ceramic valves for high-performance engines, and Instrument Development for Applied Physics, which plans to market an improved thermae anemometer within eighteen months.

- Federal and national laboratories have also been active in licensing their technologies to existing small business. Oak Ridge National Laboratory licenses about one-third of its patent portfolio to small businesses and about one-third of the cooperative agreements in its Superconductivity Pilot Center are with small companies. DOE's Ames Laboratory has licensed a copper-niobium alloy to Supercon, Inc., which is fabricating wire that combines great strength with superior thermal and electrical conductivitv.

- Federally funded research at universities has also led to substantial commercial activity. In addition to well-known spin-off activity in Silicon Valley, Route 128, and Research Triangle, thirty-five new high-tech companies were created in the past eight years using medical device technology from federally funded research at the UNiversity of Utah.

- Universities and federal laboratories are also working with state governments to establish incubator parks and other programs to assist small businesses in using federally-funded technology. Nine small firms have been started to date through the DOE-Iowa State incubator park that was established at Ames, Iowa.

2. What do you think of the Center for Advanced Technology Development located in conjunction with Ames Laboratory in Iowa?

- When I visited the Center for Advanced Technology Development I was impressed with the commitment to successful technology transfer that was evident in those running the program. Personal commitment is perhaps the greatest key to success in such efforts. In addition to commitment. The partnership established between the state government, Iowa State University, the Department of Energy

Laboratory, and the private sector is an example of the types of relationships which must be forged to leverage better both the federal investment in R&D and the ability of small high-tech firms to translate that R&D into commercially successful, innovative products and processes.

3. What are your plans for developing the type of programs such as the Center for Advanced Technology Development in the future?

- We view the Center for Advanced Technology Development as a model to be considered as a possible solution for other localities addressing the need to better leverage creative organizations located in or around other federal laboratories and/or technical educational institutions.

Senator BOSCHWITZ. We thank you as well, Mr. Mercer. We are going to interrupt the progress of this panel since Senator Rockefeller has arrived. Senator Rockefeller, I know, has another engagement at 11.

So if you would proceed, Senator, tell us about the legislation in which you have been so active to bring about a sharing of technology.

STATEMENT OF HON. JOHN D. ROCKEFELLER, A U.S. SENATOR FROM THE STATE OF WEST VIRGINIA

Senator ROCKEFELLER. Thank you, Mr. Chairman, and thank you Senator Wallop. I will try to be brief.

We have a fundamental flaw, in our system, and that is we do not use the knowledge that we have. We know how to make smaller manufacturers more efficient; how to integrate modern technology into older plants, and how to introduce statistical, quality control techniques.

Yet, the equipment and the practices of so many of our small manufacturers, small businesses, are really more appropriate to a 20th century industrial village than they are to the world that we are competing in today.

Why? In my judgment, why is the production base in one century—that is, the 20th century—and our knowledge base lagging so far behind? I think part of the answer, Mr. Chairman, is a failure in public policy.

In policy, as in manufacturing, we do not use what we know. We know how to help smaller manufacturers apply the latest techniques. We know how to deliver the information that these business people have neither the time nor the staff to obtain on their own.

Furthermore, we know that a locally based technology extension agent working with industry can transfer this information and knowledge. We know that they can do that and we know that they can improve a firm's productivity. There are many cases to show it.

For example, in my own State, West Virginia University has something called a constructed materials center, which specializes in developing new combinations of materials which will potentially have an enormous impact on infrastructure, bridges, highways, and so forth.

I will pass a piece of an I-beam which is six times stronger than steel. I think the Senators will be surprised when they feel its weight.

My State's Constructed Materials Center is also working on super cements, cements that bend, but never break—so roads would never get potholes. For those of us who have been Governors, the elimination of a pothole would be the second coming. [Laughter.]

In any event, we have that capacity.

Yet, Technology Transfer is another area in which our competitors are way ahead of us. One does not always like to fall back on Japan, but they do have a nationwide system of 185 technology extension centers, and the government pays about $235 million a year for those. That money comes from the national government.

Here in the U.S., where the cooperative extension concept was invented, we can boast of no similar service. Instead, we have a hodge-podge of struggling statewide efforts funded at perhaps $30 million a year, and reaching at most, 2 percent of the Nation's small manufacturing firms. This is why Congressman Boehlert and I worked to create a new program at NIST to help build up State technology extension services, to get technology like that out to small manufacturers.

This modest program of technical and financial assistance; established in the Omnibus Trade Act, is authorized at $2 million a year. Now, the Administration, Mr. Chairman, proposes to eliminate this fledgling effort. On what basis, I do not know. Experts continue to promote technology extension as being a major source of help for our small manufacturing firms, an essential tool for reviving American technology and manufacturing.

Most recently, the Office of Technology Assessment study, "Making Things Better", listed improving technology extension as one of the steps that must be taken to restore our competitive edge. The Administration seems to endorse this view in principle. The budget, for example, includes funding for the Hollings manufacturing centers, a program with precisely the same goals as technology extension. Indeed, our Technology Extension Program was envisioned as a way, among other things, to extend the geographic reach and technical breath of the centers. The Omnibus Trade Act makes this quite explicit.

One more paradox as well, Mr. Chairman. While the Administration strives to eliminate the Technology Extension Program, different sections of the Department of Commerce are feuding over who will run it. This has apparently caused a delay in the solicitation for grant proposals. Meanwhile, the American manufacturing economy continues to coast downhill like some under-achieving student, too distracted or short-sighted to apply its readily available skills.

Mr. Chairman, I believe Congress has to be more insistent in insuring that the Federal Government play an aggressive role in Technology Transfers. Small business is the foundation of this country, especially in a State like West Virginia. We have to do what we can to help it.

Thank you, Mr. Chairman.

Senator BOSCHWITZ. Thank you, Senator. I was not aware that your program, which I think has been funded $1,300,000——

Senator ROCKEFELLER. That is right.

Senator BOSCHWITZ [continuing]. Was on the block. That is apparently par for the course, particularly for anything new. And it is also par for the course, unfortunately, that bureaucrats are going to argue about who is going to administer the program, and each one of us in the Senate has examples of those kinds of things happening.

I certainly share your interest in this area. We should work together in trying to coordinate our efforts when these kinds of bills come before us. As you say, we have some of the tools to transfer technology, so we have the ability to improve but do not always use it.

Senator Levin, do you have any——

Senator LEVIN. Just one question or a comment for Senator Rockefeller. First, to commend him on his continuing efforts in this area. It is frustrating when those efforts get frustrated for reasons we are not really sure of yet. Do you know why no funds were requested in the 1991 budget for that Technology Extension Program?

Senator ROCKEFELLER. I do not, and I think that the Chairman, perhaps, hinted at the reason: That it is relatively new.

Senator LEVIN. Do you know whether the department asked OMB for it and OMB cut it or whether or not the department never made a request?

Senator ROCKEFELLER. Well, no, I do not know the answer to that. I do know this, that the Department of Commerce would like to have that program, and I also believe that it would be a big mistake to give the Department of Commerce that program, because I think NIST is doing very well. Don Johnson, on my right, runs it superbly. I do not know the reason. I assume it was simply because it is a new program.

[Subsequent material was received and follows:]

JOHN D. ROCKEFELLER IV
WEST VIRGINIA

United States Senate

WASHINGTON, DC 20510-4802

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April 16, 1990

Chairman Dale Bumpers
Senate Committee on Small Business
Russell Senate Office Building, #428A
Washington, DC 20510-6350

Dear Dale,

I am writing to officially amend (or supplement) the record on my response to a question that was asked of me by Senator Levin at a technology transfer hearing, held by your committee, on March 8.

On March 8, I had the pleasure of testifying before your committee. During the course of that hearing, Senator Levin questioned me about whether the Department of Commerce had requested zero funding from OMB for the technology extension program. At the time, I said that I did not know the answer to that question.

Since then, I have found out that the National Institutes of Standards and Technology (NIST) had asked Commerce Department for $4.5 million for technology extension and that it was the Commerce Department that asked OMB for zero funding.

I would like the record to reflect my answer as follows,"Yes, the Department of Commerce did indeed request zero funding from OMB for the technology extension program at NIST. However, let the record show, that NIST had asked Commerce for $4.5 million for the technology extension program -- almost double it's authorized amount."

I hope you can make this change in the record. Thank you for your help and the opportunity to appear before your committee.

Sincerely,

John D. Rockefeller IV

Senator LEVIN. Thank you. I have an opening statement that I ask be made a part of the record.

Senator BOSCHWITZ. Fine.

[The prepared statement of Senator Levin follows:]

STATEMENT OF SENATOR CARL LEVIN

SENATE COMMITTEE ON SMALL BUSINESS

MARCH 8, 1990

"Compared to our strongest competitors, the United States is lacking in institutions to diffuse technology to manufacturing companies...especially to small companies." This is the introduction to a chapter of a new report by the Office of Technology Assessment, Making Things Better: Competing in Manufacturing. Congress has attempted to address this issue, but stronger leadership on the part of the Administration is necessary. U.S. government science and technology policy is not directed toward promoting technology transfer to small companies and is focussed too heavily on basic research. We need to do a better job of getting research off the lab table and onto the drawing table at small firms.

Small businesses need more Federal assistance in the acquisition, development and use of advanced technology. The current Federal technology transfer approach is not adequate.

The Japanese government has developed a comprehensive system of assistance to the small business wishing to acquire new equipment or modernize . The Japanese small businessman has more and better financing options to choose from than does his or her U.S. counterpart. He/she has a support network of government service intended to accelerate technology diffusion. (public testing and research centers, local technology demonstration centers)

The Federal government is way behind the curve on providing U.S. small businesses with the assistance that they need to obtain or use technology. We have relied on the states to take on the burden. We should take advantage of state technology extension services that exist, like the Michigan Modernization Service and the Michigan Industrial Technology Institute. But, we need to supplement them with a coherent Federal policy that is backed up by sufficient funds.

As I discovered in my Subcommittee's hearing last December, obtaining technology is not the only barrier to its application. That is only the first step toward successful use. Perhaps an even more important step is finding skilled workers or training current employees to use new or advanced technology. Despite the critical need for

assistance in this areas, there is no direct federal effort to train and educate small business employees in the use of technology.

Whether through the expansion of the National Institute of Standards and Technology program to assist State technology extension services or through the creation of more Manufacturing Technology Centers, the Federal government must begin to play a greater role in promoting technology transfer and adoption before U.S. small manufacturing is lost forever. I hope that some of our witnesses here today will provide insight on how we can prevent that from happening.

Senator ROCKEFELLER. May I get my steel beam back? [Laughter.]

Senator WALLOP. You cannot have your steel beam back. It will remain as property of the Committee.

Jay, I agree with everything that you said, but for one thing. I mean, there is no question but what we can be doing better. No question but what we have done anything but maximize the ingenuity and talent and technical capability of this country.

The only issue I would take with you, and in this instance we could be doing better than we are, but we are doing better than you think. American manufacturing is not going downhill. American productivity exceeded that of Japan and Germany over the last few years, and—well, there is no question it could have exceeded it more, but in fact, we are not going downhill. We could be climbing a lot higher hill, the view from which would be wonderful, but I think our goal ought to be to, you know, accelerate, rather than reverse. If we get wrapped in the conversations about reversing our goal, we may find that we are actually doing more harm than good.

Senator ROCKEFELLER. Senator, I respect your opinion. I differ with it. The productivity figures for both your State and mine present difficult cases to make for an increase in manufacturing stability.

Senator WALLOP. Manufacturing stability is not the case, but we are talking about the universal statement of what takes place. You and I have serious problems because we are commodity States and trying very hard to be something more. And in that instance, there is much to be done. I do not quarrel with you that there are endless amounts that we should be doing, much that we are doing and we could be doing a hell of a lot better. I just think that as a country, I am not yet prepared to assign us to a long term decline.

Senator ROCKEFELLER. Understood. Thank you. I thank the Committee very much. Thank you for allowing me to interrupt also, Mr. Chairman. That was very kind.

Senator BOSCHWITZ. Thank you very much, Senator.

We now turn to Dr. Chen, who is the Associate Director of Intramural Affairs and Chairman of the Patent Policy Board. And I would ask first, tell us what is Intramural Affairs at the National Institutes of Health, what that means.

I thank you, Mr. Mercer, for stepping outside to make the acquaintance of Mr. Shuster.

Mr. MERCER. I am delighted. He has a program I would very much like to learn about.

Senator BOSCHWITZ. Yes. I was also fascinated by it, and it seems to be quite a small business-type of approach—quite a direct way of dispersing the information that seems to be so elusive.

Mr. MERCER. We have already arranged to go have our own personal Technology Transfer conference tomorrow afternoon.

Senator BOSCHWITZ. Good, that is just what I wanted to achieve, and so I thank you.

Dr. Chen, so what is Intramural Affairs at the National Institutes of Health?

STATEMENT OF DR. PHILIP S. CHEN JR., ASSOCIATE DIRECTOR OF INTRAMURAL AFFAIRS, NATIONAL INSTITUTES OF HEALTH

Dr. CHEN. Chairman Boschwitz, Senator Wallop, Senator Levin, I am pleased with this opportunity to describe the positive experiences we at the National Institutes of Health have had in implementing closer collaborations between Government and industry scientists, as encouraged by the Federal Technology Transfer Act. Our Agency has already been mentioned favorably by Mr. Wyden in his remarks.

You asked about the Intramural Program. This refers to our in-house laboratories and clinics located mainly in Bethesda, MD, but also in several other locations around the country, and this represents for about one-eighth of the total NIH budget. Even though it is the smallest fraction of our budget, it still accounts for the largest biomedical research organization in this country, and we believe in the world.

Of our budget, 80 percent is spent in an extramural program of grants, contracts, and training awards, which then go to some 20,000 grantees.

Over one-fourth of the total of some 130 Public Health Service, cooperative research and development agreements or CRADAs, approved thus far, have been with small businesses and are thus of special interest to this Committee. These companies and CRADAs are listed in an attachment in my written testimony, submitted for the record.

In the testimony, I described the oversight function of the Patent Policy Board and its working subcommittees, and outline the responsibilities assumed by the Office of Technology Transfer established to support the myriad activities required to operate a responsive and effective program.

An example of one of these activities is the focused training sessions for our staff, and for which a comprehensive syllabus has been prepared. This is a copy of the syllabus that is given to everyone that attends the training session.

Five general principles have guided the NIH in developing our policies and procedures. These relate to awareness of our central mission in the intramural program to conduct basic biomedical research, adoption of procedures which do not unduly complicate that research, recognition that public and industrial health both benefit from efficient technology transfer, decentralization of Technology Transfer authority, and involvement of industry in the review of emerging policies, and draft model agreements.

An example of the latter process is last week's Technology Transfer conference sponsored jointly by NIH and by the Pharmaceutical Manufacturer's Association (PMA), that was held at the Georgetown University Conference Center.

We have been proactive in efforts to assure equal access to all companies that wish to explore collaboration opportunities. In October 1988, we instituted an Annual Industry Collaboration forum to bring together interested industry and government scientists. A second very successful forum was held in October 1989. A directory is published in conjunction with each forum—this is a copy of the directory—and is later available to anyone on request.

A new electronic bulletin board, expected to be in place late this spring, will be able to provide downloadable copies of our guidelines and model agreements, a directory of our investigators, and full text files of patent applications available for licensing. Other files will provide information on existing CRADAs, executed license agreements and special announcements, such as upcoming conferences.

Although the Technology Transfer Act encourages the use in a CRADA of Government resources, it does not permit the Government to provide funds utilizing the CRADA as a support mechanism. The Patent Policy Board has adopted a policy, however, that allows small businesses to use SBIR funds in support of their activities on a CRADA. Some small businesses are thus receiving both SBIR financial assistance and CRADA intellectual assistance from the Government

Illustrative of CRADAs with small businesses are several examples. First, in the treatment of urinary incontinence, Urosystems Inc. in Sunnyvale, CA, is commercializing new technology for managing urinary incontinence, employing implantable neurostimulators to correct abnormal nerve function. In order to explore alternative approaches, the company has entered into a CRADA with the NIH Biomedical Engineering and Instrumentation Branch to develop an intraurethral valve. It has also licensed an existing NIH patent for an early prototype urethral valve.

A second example relates to therapeutic products for AIDS. Genelabs, Inc., in Redwood City, CA, is developing therapeutic products for the treatment of AIDS and of other immune disorders and cancer. It has a CRADA for studying candidate anti-HIV compounds with the National Institute of Mental Health, but it also collaborates with Stanford University and the San Francisco General Hospital. Such multiple collaborative activities are commonplace for small biotechnology companies.

A third example relates to enhanced drug delivery systems. Integrated Genetics, Inc. is a subsidiary of Gemzyme Corp., of Boston, MA, a diversified health care products company. It is also a commercial service laboratory that uses DNA probes for genetic, prenatal and presymptomatic testing. Through a CRADA with the National Cancer Institute, the company is collaborating on a study of a new type of cytokine that ultimately may provide ways to target drug delivery or to enhance the cellular uptake of drugs.

In summary, the NIH, together with its sister Public Health Service agencies, is conducting a range of Technoloy Transfer activities designed to respond successfully to the directives of the Technology Transfer Act. There has been a resulting, heightened awareness and utilization by both small and large businesses of research collaboration opportunities. We believe that our program will result in a substantial contribution to the public health, to U.S. industrial competitiveness, and to the quality of our own intramural research enterprise.

I want to thank you, Mr. Chairman, for this opportunity to present a perspective from NIH's point of view on implementation of the act, and I will be pleased to try to answer any questions the Committee may have.

[The prepared statement of Dr. Chen follows:]

FOR RELEASE ON DELIVERY

Testimony by

Philip S. Chen, Jr., Ph.D.
Associate Director for Intramural Affairs
and Chairman, Patent Policy Board

National Institutes of Health
U. S. Public Health Service
Department of Health and Human Services

on the

Implementation of the Federal Technology Transfer Act of 1986 at the National Institutes of Health

before the

Senate Committee on Small Business

March 8, 1990

Thank you for this opportunity to describe the technology transfer policies and programs of the National Institutes of Health (NIH), as implemented pursuant to the Federal Technology Transfer Act of 1986 (FTTA). Broadly defined, "technology transfer" could be considered to include, for example, our publication of over 7,000 scientific journal articles annually, the sharing of research materials under a suitable material transfer agreement, and the convening of Consensus Development Conferences by the Office of Medical Applications of Research. This testimony, and the use of terms such as "technology," "technology transfer" and "technology management," is focused, however, on activities under the FTTA. Within the U.S. Public Health Service, the NIH and the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) have joined together to coordinate technology management and patent licensing, and the Centers for Disease Control (CDC) is expected to join this administrative union later in the Spring. Thus, unless it is otherwise clear from the context, reference to NIH should be understood to include ADAMHA and CDC.

Under the auspices of the FTTA, the NIH, ADAMHA, CDC and the Food and Drug Administration (FDA) have entered into about 130 Cooperative Research and Development Agreements (CRADAs), of which over one-fourth are with small business (see attachment A). Our CRADAs vary widely in their research projects, and include the development of AIDS therapeutics, diagnostic test kits for cancer and infectious diseases, transgenic animals, genetic therapy, and various types of bioinstrumentation. These agencies share annual earned royalties of about $5 million among about 205

inventors, through the licensing of about 150 inventions. In view of the quality and clarity of their respective technology transfer guidelines and model forms of agreement, as well as their total number of CRADAs and a cumulative royalty income of over $14 million from patent licensing since the enactment of the FTTA, the PHS research agencies are acknowledged leaders amongst the Federal laboratories in meeting the mandates of the FTTA.

Implementation of the FTTA at NIH reflects five general principles: (1) awareness of our central mission as a basic biomedical research institution, (2) adoption of procedures that complement but do not unduly complicate our research efforts, (3) recognition that public health and U.S. industrial competitiveness both are served by efficient technology transfer activities, (4) decentralized technology transfer authority, and (5) the involvement of industry in the review of emerging policies and draft model agreements. These principles are evident in the history of our technology transfer programs and in the discussion of our current major program initiatives that follows a brief background.

Background:

At NIH, authority to implement the FTTA has been delegated to me by the Director, in my capacity as Associate Director for Intramural Affairs. As part of this responsibility, I chair the NIH/ADAMHA Patent Policy Board, which advises the Director, NIH and Administrator, ADAMHA on matters relating to patents specifically,

and technology transfer generally. The Board is composed of senior scientists and administrators of NIH and ADAMHA, as well as liaison representatives of the Centers for Disease Control (CDC), the Food and Drug Administration (FDA) and the Office of the Assistant Secretary for Health. Certain technology transfer authorities have been retained at the PHS organizational level, and the Deputy Assistant Secretary for Health (Science/Environment), has been designated to serve as the focal point for technology transfer matters at the PHS. Although now disbanded, an interagency Technology Management Advisory Board, chaired by the former Deputy Assistant Secretary for Health, played a key role in developing policy for the early PHS implementation of the FTTA, on various issues such as 'pricing" and "fair access" to PHS laboratories.

Several working subcommittees of the Patent Policy Board bear primary responsibility for the management oversight of activities discussed in greater detail below. For example, the Training Subcommittee plans and coordinates semiannual training seminars to teach the NIH and ADAMHA communities about patenting, technology transfer and CRADAs. The Forum Subcommittee has planned and implemented two highly successful collaboration fora to explain the technology transfer programs of NIH and ADAMHA to industry and introduce interested investigators to potential CRADA partners. The CRADA Subcommittee helps develop the NIH/ADAMHA model CRADA and presently reviews about five CRADA proposals per month on behalf of the Director, NIH and Administrator, ADAMHA. The Royalties Subcommittee develops policies for the sharing of royalties with inventors and

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for the appropriate use of royalty monies. The Data Systems Subcommittee is responsible for implementing automated data processing requirements for the NIH technology transfer programs.

At the central NIH level, the "Office of Technology Transfer" (OTT), formerly known as the Office of Invention Development, is the technology management focus at the NIH for implementation of the FTTA. In this capacity, the OTT monitors, evaluates and shapes the technology transfer portfolio of the NIH, ADAMHA and CDC. The OTT also serves in a staff capacity for the Patent Policy Board, and prepares initial drafts of policy guidelines and model agreements, such as our model CRADA. The OTT has the primary responsibility for developing and implementing the technology transfer program initiatives discussed below. The senior staff of the OTT were recruited from outside of the NIH, and have proven to be an exceptionally valuable and productive resource for the PHS research community.

Within each of the component institutes, centers and divisions of NIH and ADAMHA, a critical role is played by the designated "Technology Development Coordinator" (TDC). The TDC is responsible for shepherding draft CRADAs from the investigator's bench through an internal review mechanism to the OTT and the Office of General Counsel (OGC), prior to ultimate review by the CRADA Subcommittee. In addition to serving frequently as a point of first contact with industry, the TDC also evaluates "material transfer agreements" (MTAs) to coordinate sharing and receiving of research materials. The TDCs meet monthly with the Director and senior staff of the

OTT to discuss problems and concerns of mutual interest. Several of the institutes, centers and divisions also benefit from the efforts of a specially-designated "Invention Coordinator" who facilitates the processing of invention reports and the filing of patent applications.

Information Management:

The careful management of technology-related information serves three essential day-to-day functions; evaluation and development of our technology portfolio, cost control for our patenting and licensing efforts, and the communication of the breadth and availability of this portfolio as a valuable resource to its direct users, industry. A fourth information management function requires that information related to CRADAs be available electronically in order to monitor the program and respond to inquiries from the General Accounting Office, the Department's Office of Inspector General and other Congressional and Executive Branch offices.

The OTT presently is working with the Procurement Division of the NIH to acquire a commercial patent docketing system to track the status of our domestic and foreign patent applications. The status of license applications and executed license agreements also will be tracked by this system. This docketing system is essential to effective technology management at NIH, since over 200 patent application filings are anticipated for FY 1990. A specialized access protocol will permit each of our component institutes, centers and divisions to monitor costs of patent prosecution by

inventor, subject or total portfolio. Moreover, the OTT and the Office of Federal Patent Licensing of the National Technical Information Service (NTIS) will be able to access the data base and update information on an ongoing basis. The CDC and FDA also will have direct access to the docketing system as remote users.

An effort of major significance for our technology transfer programs involves the development of an electronic bulletin board that will be accessible via modem by any interested company. The board, expected to be operational late this Spring, will provide downloadable copies of PHS technology transfer guidelines and model agreements, a directory of PHS investigators interested in collaborative research projects with industry, and downloadable full text files of patent applications available for licensing. Other files on this bulletin board will provide information on existing CRADAs and executed license agreements. Special announcements, such as upcoming conferences, will also be made.

A clear accounting of the extent and status of the patent applications and patents in our licensable technology portfolio will aid the OTT in prioritizing various inventions for technology transfer efforts and in focusing its energies more efficiently. The information provided in the two data bases described above also should facilitate cost containment.

The Division of Computer Research and Technology (DCRT) at NIH developed and is now field testing a custom software package that will contain information about all of the CRADAs entered into by the PHS agencies. These data will permit rapid

oversight of the entire CRADA portfolio. The system is expected to facilitate responses to technology transfer surveys conducted by the Government Accounting Office, the Department's Office of Inspector General and others.

The automated data processing needs of the OTT and our overall technology transfer programs will be reviewed continually by the Patent Policy Board and its Data Systems Subcommittee in order to achieve a responsive and aggressive information management effort.

Administration and Training:

The day-to-day administration of our technology transfer programs is vested in the OTT, which coordinates policy development, provides staff work for the Patent Policy Board, establishes a liaison with the constituent institutes, centers and divisions of NIH, interfaces with industry, and represents NIH at interagency technology management conferences and work groups. We routinely share information and exchange visits with sister laboratories, particularly the Agricultural Research Service of the USDA located in Beltsville, Md. and the National Institute of Standards and Technology located in Gaithersburg, Md. The job of Federal technology transfer is important and difficult enough that we endeavor not to reinvent wheels invented by our colleagues.

The training and education of our own scientists and support staff about technology transfer and collaborative opportunities with industry are other key elements

of our program. To this end, we hold semiannual training seminars that explain the rudiments of patenting, licensing and CRADAs to the PHS scientific community. A training notebook, provided separately to this Committee, is also distributed widely throughout the PHS. Additionally, the OTT sponsors a monthly speaker series known, appropriately for NIH, as the "Technology Transfer Grand Rounds." Guest lecturers from industry, venture capital and the patent bar, for example, have given very informative and well-received presentations. Our training programs are intended to minimize the possibility that inadequate or insufficient working knowledge about technology transfer might become the rate-limiting step in our overall technology transfer program.

Technology Evaluation:

To a great extent, we believe that it is the role principally of industry to decide whether any of our inventions merit commercial evaluation. We thus attempt to err on the side of making a wide range of (even marginal) technology known to the private sector. Notwithstanding this approach, fiscal realities dictate that we must be somewhat selective in pursuing, for example, the filing of patent applications that reasonably appear to be both patentable and of potential commercial interest.

Two questions typically are asked about inventions: are they patentable, and are they commercially viable. The Patent Branch of the Department's Office of General Counsel recently has expanded its staff and is now able to offer prior art searches and

evaluations to the Technology Development Coordinators. The OTT, through the Technology Management Branch, similarly provides preliminary evaluations of commercial marketability. Based on these two evaluations, our institutes, centers and divisions can make educated decisions about the investment of funds required to file patent applications.

The Patent Policy Board has considered at various times the establishment of an NIH-wide invention review panel. This idea has merit for bringing together a group that can exercise judgment based on the overall PHS technology portfolio. Similar invention review committees are used by some companies for analogous purposes. The OTT presently is evaluating the establishment of such a review panel at NIH to be composed of knowledgeable scientists within the PHS and other Federal agencies, including the Department of Commerce and the Office of Science and Technology Policy.

All-in-all, a better working knowledge of our overall technology portfolio and a consistent approach to decision making in technology management will enhance our effectiveness and efficiency in transferring Federal technology from the PHS laboratory to the private sector.

Technology Management:

The technology management program at NIH under the FTTA is an ongoing managerial function of the OTT to review and evaluate the technology portfolio of

NIH, ADAMHA and CDC, to monitor the scientific and business literature in order to identify and approach companies likely to have a licensing or collaboration interest, and to package together when appropriate for licensing those units of our technology portfolio that form a commercially useful grouping.

The central element in our technology management process is the "Technology Management Team Meeting," held monthly to review the licensing potential of newly-filed patent applications on a case-by-case basis. Attending these meetings are the inventors named on a particular patent application, their Technology Development Coordinator, the OTT Director and the OTT Technology Management Branch and Technology Licensing Branch Chiefs, a Patent Branch attorney and a licensing specialist from the NTIS. As background for these meetings, the Technology Management Branch performs a detailed analysis of the product for which a patent is being sought, evaluates likely product markets in various fields of use, and attempts to identify potential licensees. Thereafter, discussions at the TMT meetings include a review of the subject patent application and all other related applications from anywhere in the PHS, current research and potential CRADA interests of the inventors, and an evaluation of companies likely to have an interest in licensing or collaborating in further research.

The OTT also is compiling a data base that identifies the persons responsible for business and product development and for licensing at pharmaceutical, biotechnology and other companies that are potential licensees or collaborators. This data base is key

word searchable, and is proving to be a highly useful technology management tool.

An important component of technology management, now receiving increasing attention, is the enforcement of patent rights against infringers and of license obligations against licensees. A credible technology transfer program requires the licensor, here NIH, to demonstrate that its patents are defensible and will be defended; and that noncompliance with its license terms will not be overlooked or tolerated. Historically, the Department has not maintained a stable of patent litigation experts, but we presently are evaluating the kinds of in-house services required for the technology transfer program and the associated hiring practicalities. This staffing concern reflects a reality that, for the NIH, the development of an effective technology transfer program reflects a present investment in people and procedures even though royalty return to the laboratories may temporarily be deferred.

Technology Licensing

In carrying out the licensing function of our program, the OTT facilitates and oversees licensing activities carried out by the Office of Federal Patent Licensing of the National Technical Information Service. It also directly handles licensing of inventions made under CRADAs, for which the first patent license negotiations have recently begun. Licensing negotiations will be carried out using, as a starting point, a model patent license agreement drafted by the OTT and recently circulated for comment to industry and academic licensing specialists.

Under the FTTA, royalty income is shared with inventors and the laboratories, and helps to cover technology transfer costs such as patent application expenses. NIH and ADAMHA currently earn royalties from about 150 active patent licenses, and the pace of licensing activity is picking up, both in response to the technology transfer activities of our program, and to the recognized value of these biomedical technologies to the health care community.

Industrial Liaison:

The industry liaison aspect of our program endeavors to communicate actively with the various sectors of the biomedical industry in order to identify the NIH as a significant source of technology for licensing and as a valued collaborator in joint research and development projects.

The NIH and ADAMHA held our second annual "Industry Collaboration Forum" last October to explain our various technology transfer programs to industry, and to present in poster form specific projects for which our investigators were seeking potential industry collaborators for CRADA purposes. Over 70 industry representatives attended and 106 research posters were available for viewing. Next Fall, the Forum as presently planned will take place in a new format of two half-day sessions devoted to topical areas such as bioinstrumentation, transgenic animals and cancer diagnostics. Small businesses view the CRADA as a way to leverage limited financial resources available for research and development. The prospect of an option for an exclusive

license on inventions developed under the CRADA also particularly attracts small businesses as a way to enhance their own proprietary positions.

The NIH also co-hosted a major, two-day technology transfer conference with the Pharmaceutical Manufacturers' Association last week on March 1-2 that was attended by over 200 representatives from industry, academia and government. This particular program was a highly successful sharing of information and viewpoints, according to the participants, on a number of issues of current debate. Through collaborative efforts of this type, we are able to focus collective thinking and discussion on the various policies and procedures under consideration at NIH as well as at the major university technology transfer offices. Similar conferences, on a somewhat smaller scale, are contemplated for later this year to involve industry and academia in evaluating the role to be played by the PHS in the technology transfer aspects of the human genome sequencing project and of transgenic animal research.

Focused efforts are made to communicate with small business concerns, through activities such as contacts with regional trade organizations in which small business is the major constituent group. For example, presentations were made within the past few months by OTT senior staff to the Massachusetts Biotechnology Council and to the Montgomery County (Maryland) High Technology Council. At such events, information about our technology transfer programs is distributed and we receive valuable feedback both during the question and answer discussion and subsequent follow-up interactions with participants.

Policy developed by the NIH/ADAMHA Patent Policy Board permits companies receiving Small Business Innovation Research (SBIR) awards from the NIH to utilize these funds in a CRADA collaboration. Special efforts also are made to assist small business in understanding and utilizing the NIH technology transfer programs. Generally, the larger, longer-established companies have an experienced business development counterpart to our OTT. Thus, it has become a priority to spend extra time with potential collaborators and licensees from small business firms that may lack experience in accessing government technology resources or lack familiarity with the applicable statutory and regulatory systems. Most of these initial contacts are handled personally by the OTT Director.

Conclusions:

In summary, the NIH, together with its sister PHS agencies, is developing a technology transfer organization and a range of technology transfer activities designed to respond successfully to the directives of the Federal Technology Transfer Act. We believe that the results of this program already demonstrate an enhanced transfer of technology to U.S. industry and an heightened awareness and utilization by both small and large U.S. businesses of PHS technology and research collaboration opportunities. We further believe that the program has made a substantial contribution to the public health and to U.S. industrial competitiveness, as well as to the quality of our own research program.

Thank you Mr. Chairman, for this opportunity to present the NIH experience on implementation of the FTTA. I will be pleased to answer questions from you and the Committee members.

ATTACHMENT A

February 28, 1990

CRADAs WITH SMALL BUSINESSES

NATIONAL INSTITUTES OF HEALTH:

National Institute on Aging

Athena Neurosciences

"To Conduct Research and Development Relating to Drug Design and Delivery to the Central Nervous System"

National Institute on Allergy and Infectious Diseases

Molecular Vaccines, Inc. (3)

"Identification of HIV Antigens Which Stimulate Humoral and Cell Immune Responses"

"Vaccinia Vectors for AIDS Vaccine Research (HIV)"

"Vaccinia Virus Expression Vectors"

Transgenic Sciences, Inc.

"Transgenic Rabbits for HIV-1 Infection"

Chiron Corporation

"Clinical Education of a Recombinant **Herpes Simplex** Virus Type 2 Glycoprotein Vaccine"

MicroGenSys, Inc. (2)

"In Vitro Expression of Respiratory **Syncytial Virus Genes** and Parainfluenza Type 3 Virus Genes in Baculovirus"

"In Vitro Expression of AIDS Retrovirus **Genes**"

National Institute on Allergy and Infectious **Diseases/National** Cancer Institute

IMMUNO

"AIDS Vaccine Development"

National Cancer Institute

NeoRx Corporation

"Monoclonal Antibodies"

Integrated Genetics

"Cytokines for Enhancing Drug Delivery and Pharmacologic Action"

Loftstrand Labs, Ltd.

"Development of Methods for PCR Amplification of DNA Sequences Directly from Clinical Specimens"

British Biotechnology Limited

"Vaccine for the Prevention of AIDS"

Molecular Oncology, Inc.

"Metastase Suppressor Gene (NM23)"

Centocor (2)

"Development of Novel Radioimmunoassays for the Detection of Tumor-Associated Antigens in the Sera of Cancer Patients"

"Development of Novel Radioimmunoassays for the Detection of Tumor-Associated Antigens in the Sera of Cancer of Patients and Developing Cancer Diagnostic

Reagents Consisting of Specific Monoclonal Antibodies"

Celltech Limited

"Development of Specific Recombinant Monoclonal Antibodies and/or Modifications of Immunoglobulins"

National Institute of Child Health and Human Development

Electropore

"Use of Electropore's Prototype Cell Poration Device (Access II)"

National Institute of Diabetes and Digestive and Kidney Diseases/National Institute of Child Health and Human Development

Integrated Genetics

"Production of Human Pharmaceuticals in the Milk Transgenic Animals"

National Heart, Lung and Blood Institute

Genetic Therapy, Inc. (3)

"Tissue-Directed Gene Transfer"

"Retroviral-Mediated Gene Transfer for AIDS Therapy"

"Retroviral Mediated Gene Transfer Into Bone Marrow Cells and T&B Lymphocytes"

Xoma Corporation

"Phase I/II Study to Determine the Safety and Efficacy of Xomazyme-H65 in Moderate to Severe Acute Aplastic Anemia"

National Institute on Neurological Disorders and Stroke

Receptor Genetics, Inc.

"Cloning and Expression of Human Neurotransmitter Receptors: Acetylcholine, Dopamine, and Glutamate"

Applied Biosystems

"Megabase DNA Sequencing"

Biomagnetic Technologies, Inc.

"LOAN Agreement for Magnetically Shielded Room"

National Center for Research Resources

Urosystems, Inc.

"Prosthetic Urethral Valve Development"

ALCOHOL, DRUG ABUSE AND MENTAL HEALTH ADMINISTRATION:

National Institute of Mental Health

Monoclonetics

"Serum Protein Patterns"

Bio-Brite, Inc.

"Clinical Testing of Portable Light Dosage System"

RRI

"Study of AIDS in Infected Rabbits for Vaccine and Drug Development"

Integra Institute

"Possible Autoimmune and Viral Etiologies of Schizophrenia"

Genelabs, Inc.

"Peptides that Block HIV"

CENTERS FOR DISEASE CONTROL:

Center for Infectious Diseases

GeneLabs, Inc. (2)

"Transfer of Posttransfusion non-A, non-B Hepatitis Viral Antigens"

"Cloning of Enterally Transmitted Non-A, Non-B Hepatitis Virus"

Thermascan, Inc.

"Clinical Study of A Diagnostic Assay Kit to Detect Antibodies Against Parasitic Diseases"

Cryolife, Inc.

"Development and Growth Characteristics of a Human Hepatype Cell Line"

Weiner Laboratories

"Particle Agglutination Test for the Detection of Hepatitis B Surface Antigen"

FOOD AND DRUG ADMINISTRATION

G.K. Scientific, Inc.

"Testing and Evaluation of Electrophoresis Funnel Apparatus"

Transgenic Sciences, Inc.

"Research and Development on In-Vitro Toxicology Tests"

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892
Building 1
Room 140
(301) 496-3561

March 30, 1990

Senator Dale Bumpers
Chairman
Committee on Small Business
United States Senate
Washington, D.C. 20510-6350

Dear Mr. Chairman:

Thank you for providing the National Institutes of Health with the opportunity to testify before your committee on March 8, 1990, about our technology transfer program and small business. In follow-up to the hearing record, your letter of March 16 requested responses to several questions, which I have addressed below.

Question 1: Can Small Business Innovation Research (SBIR) grants be used for Cooperative Research and Development Agreements (CRADAs)?

Response: NIH policy permits SBIR funds received by a small business to be used to support its activities under a Cooperative Research and Development Agreement. The rationale for this policy is that SBIR Grants are specifically aimed at stimulating product commercialization. Under such circumstances, a small business would be able to benefit by receiving from the government both intellectual assistance -- through a CRADA, and financial assistance -- through the SBIR Grant, for research and development activities directed toward the development of a commercializable product.

Question 2: Given the success of your technology transfer program at the National Institutes of Health (NIH), do you have plans to share your approach with other agencies, or have any other agencies asked for your recommendations on improving technology transfer methods?

Response: The successful experience of the National Institutes of Health in developing and implementing its technology transfer policies has been widely shared with other government agencies and the outside community through a variety of mechanisms. A principal forum is at the regular discussions of the Executive Working Group of the Interagency Committee on Federal Laboratory Technology Transfer, chaired by the Department of Commerce. Various documentary materials that we have developed have been shared with representatives of the other government agencies. In addition, representatives of such agencies have been invited to attend various meetings at the NIH or in which the NIH

participates, such as the Annual NIH/ADAMHA-Industry Collaboration Forum, the Semi-Annual Technology Transfer Training Sessions held for NIH scientists and administrators, the monthly Technology Transfer Grand Rounds, and events like the Technology Transfer Conference sponsored by the NIH and the Pharmaceutical Manufacturers Association on March 1-2, 1990 at the Georgetown University Conference Center.

Indeed, a number of other government agencies have asked the NIH for information, assistance, and recommendations on improving their Technology Transfer Programs. The staff of the NIH Office of Technology Transfer as well as other NIH staff have freely shared our experiences and provided copies of the training syllabus, the forum directory, the various model agreements and other materials.

Question 3: Your testimony discusses the implementation of an electronic bulletin board. How far are you from offering it to businesses and what sort of fees if any will be charged for this information?

Response: The planned electronic bulletin board, to be implemented by the Office of Technology Transfer later this spring, is intended to be freely available to any organization or individual and accessible by a telephone call. No fees will be charged to the outside user. Of course the bulletin board will also be of considerable use to our own in-house staff, such as the technology development coordinators and our intramural scientists and inventors themselves. We hope to use the electronic bulletin board as a principal outlet for providing information to the biomedical community at large so that anyone in the country can have immediate access to useful information about on-going activities in the NIH technology transfer program, and information for potential CRADA partners and license applicants.

Please feel free to contact my office at any time if we can be of assistance.

Sincerely yours,

Philip S. Chen, Jr.

Philip S. Chen, Jr., Ph.D.
Associate Director for Intramural Affairs

Senator BOSCHWITZ. The Chairman of the Committee has joined us, and so I would turn to him. Dr. Chen would you send up that material, please?

Senator BUMPERS. Mr. Chairman, I would defer to you. This is really your hearing and I have a statement I would like to insert in the record, and later on I will get involved in the questioning.

[The prepared statements of Senators Bumpers, Dixon, and Lott follow:]

STATEMENT OF

SENATOR DALE BUMPERS

CHAIRMAN, SENATE SMALL BUSINESS COMMITTEE

MARCH 8, 1990

This morning the Small Business Committee is examining an issue which has become a Washington buzzword, but which has fundamental importance for small business, technology transfer. Technology affects every sector of the economy. Small businesses in the United States are challenged to enter a new phase of global competition never seen before. One key to success for U.S. firms in the international marketplace is to acquire appropriate technology. The federal government must help businesses meet this long-term challenge.

I am pleased that Professor William Rader, Director of the Arkansas Center for Technology Transfer (ACTT), is here to testify before the committee today. His efforts to make technology transfer practical and accessible to small- and medium-sized firms deserves to be commended. The practical, hands-on technology transfer conducted by the ACTT is credited with returning $7.28 to the state treasury for every one dollar

received from the state. This pragmatic and efficient approach to technology transfer should be encouraged.

Professor Robert Reich, in a recent commentary, said that the United States must come to grips with the growing economic challege of the nations on the Pacific rim and, to a somewhat lesser extent, Europe as well, which will prove as profound as the challenge of communism was over the last fifty years. While we practice Free Market Capitalism, he said, many of our friends and competitors practice National Capitalism. The American business and government view has been to ignore national boundries in the development of our economy. The Asian view, Reich added, is for capitalism and nationalism to reinforce each other.

In the long run, National Capitalism may prove a more potent adversary than the socialist command economy ever was, because it combines two of the most profound historical forces--national pride and the productive force of free markets. The point is that while many in America still are hesitant to see government and business working too closely together toward common goals, our competitors have no such compunction. Much of the success of the Japanese economy, in my view, stems from the persistent efforts of the Ministry of International Trade and Industry to

ensure that Japanese firms acquire and utilize the very highest level of productive technology available.

Meanwhile, American small firms have been left to fend for themselves in the increasingly complex and intimidating world where such acronyms as CAD-CAM--computer aided design/computer assisted manufacturing--are becoming the mainstays of international competitiveness.

Due to the practical limitations of time and money, most small businesses lack the ability to penetrate the federal labyrinth to engage in technology transfer activites. While the Federal Laboratory Consortium for Technology Transfer has attempted to increase small company access to federal research and development, most small businesses have had limited interaction with the government.

Many problems can be identified on the technology transfer landscape. While I applaud the individual efforts of many executive branch officials, I believe President Bush has only paid lip service to the importance of technology and has yet to provide leadership on this issue. The President has been in office for over a year, and he has failed to name an Under Secretary for Technology at the Commerce Department, although I understand that a prospective nominee is now under consideration.

But at this point, the President has also failed to articulate a national agenda for technology policy, and mixed messages are sent about the importance of technology transfer.

For example, the Administration's FY '91 budget has endorsed the Hollings Manufacturing Technology Centers. In FY '90, Congress provided $1.3 million to fund the Boehlert-Rockefeller Technology Transfer Extension Program at the National Institute of Standards and Technology (NIST) through an amendment which I offered to the Commerce-Justice appropriations bill. This program is fully consistent with the principles of the Hollings Centers. Despite the evaluations by NIST officials that the technology extension program providing technical assistance and grants is one of the most useful and cost-effective of the new programs to help industry, the President's budget submission for FY '91 zeros out funding.

The program is relatively inexpensive, but the small amount of funding can bolster state initiatives in states like Arkansas, which are unlikely to be able to compete with manufacturing giants like New York and Ohio for Hollings Center funding. In short, while the Administration supports the Hollings Centers, it fails to support an extension service program which could reach many more small businesses at less cost. I believe the President

should reexamine this issue, and I intend to seek increased funding for the extension program this year.

I would like to commend the National Institute of Standards and Technology for its efforts in the area of technology transfer, especially the leadership of Don Johnson. NIST maintains an excellent rapport with the academic community and with the States, which should prove valuable in the implementation of the Technology Transfer Extension Program.

I was encouraged to review the testimony of Dr. Bromley before the House Subcommittee on Regulation, Business Opportunities, and Energy during last fall's hearing on technology transfer. I believe Dr. Bromley is dedicated to this issue and is keenly aware of its importance for the future. Last fall, Dr. Bromley noted that it would take more than a 500-pound gorilla in the area of technology transfer to gain some unity in the policy administration of the various federal agencies. I am interested to learn whether Dr. Bromley received the necessary "hammer" to sort this problem out. I am also interested in hearing a progress report on the technology assessment report being conducted by the White House Office of Science and Technology.

With bipartisan support, Congress has repeatedly attempted to encourage technology transfer by providing incentives to industry to increase innovation-related activities and eliminating obstacles to technology development in the private sector. I remain committed to assisting individual state technology transfer initiatives, to helping small businesses make sense of the reservoir of federal technology, and to overseeing the implementation of the technology transfer extension service provisions of the trade bill. I am pleased to welcome our distinguished panel of witnesses for today's hearing, and I look forward to their testimony.

STATEMENT BY SENATOR ALAN J. DIXON

BEFORE THE SENATE SMALL BUSINESS COMMITTEE

ON

TECHNOLOGY TRANSFER AND SMALL BUSINESS

MARCH 8, 1990

MR. CHAIRMAN, I LOOK FORWARD TO THE TESTIMONY THIS MORNING CONCERNING THE TRANSFER OF GOVERNMENT FUNDED TECHNOLOGY INTO THE PRIVATE SECTOR, AND SPECIFICALLY INTO THE SMALL BUSINESS COMMUNITY.

THIS SUBJECT HAS A GREAT DEAL OF RELEVANCY WITH TESTIMONY MANY OF US HAVE RECENTLY HEARD CONCERNING THE LOSS OF AMERICAN COMPETITIVENESS IN HIGH TECHNOLOGY AREAS. OF SPECIFIC CONCERN TO ME IS AMERICA'S GROWING DEPENDANCE ON FOREIGN COMPONENTS IN OUR DEFENSE WEAPONS, WHICH I HAVE ADDRESSED IN SENATE BILL S.1379 TO REAUTHORIZE AND AMEND THE DEFENSE PRODUCTION ACT OF 1950.

WE MUST, AS A NATION, TAKE EVERY ADVANTAGE TO STEM OUR ECONOMIC AND COMPETITIVENESS SLIDE. ONE OPPORTUNITY AVAILABLE TO US IS IMPROVING THE COMMERCIALIZATION OF GOVERNMENT FUNDED RESEARCH, ESPECIALLY IN OUT VAST AND HIGHLY CAPABLE SMALL BUSINESS SECTOR.

I WOULD LIKE TO TAKE THIS OPPORTUNITY TO COMMEND THE CHAIRMAN FOR HOLDING TODAY'S HEARING. I LOOK FORWARD TO THE COMMENTS OF MY COLLEAGUE, THE DISTINGUISHED SENATOR FROM WEST VIRGINIA, ON THIS ISSUE AS WELL AS THOSE OF OUR GOVERNMENT AND PRIVATE SECTOR PANELISTS.

STATEMENT OF SENATOR LOTT

TECHNOLOGY TRANSFER HEARING

MR. CHAIRMAN--FIRST OF ALL I WANT TO THANK YOU FOR HOLDING THIS HEARING ON A SUBJECT THAT IS EXTREMELY IMPORTANT TO ME.

IT IS A COMMONLY KNOWN FACT THAT WHEN IT COMES TO INNOVATION AND NEW TECHNOLOGY--AMERICA'S SMALL BUSINESSES ARE ALWAYS CLOSER TO THE CUTTING EDGE. IT ONLY MAKES SENSE, THAT OUR JOB SHOULD BE TO SEE THAT WE ASSIST IN THIS PROCESS AND MAKE EVERY ATTEMPT TO AVOID HINDERING SMALLER ENTERPRISES IN THEIR EFFORTS.

ONE OF THE BIGGEST CONCERNS I HAVE HAD OVER THE PAST FEW YEARS, IS THE FACT THAT CONGRESS AND THE GOVERNMENT AGENCIES IN CHARGE OF ADMINISTERING PROGRAMS SPEND A GREAT DEAL OF TIME TALKING ABOUT THE TRANSFER OF TECHNOLOGY---YET MANY SMALL BUSINESS PEOPLE THAT I HAVE SPOKEN WITH ARE HAVING TROUBLE FINDING HELP WHEN IT ACTUALLY COMES TO TAKING THIS NEW TECHNOLOGY TO THE FREE MARKET.

AN EXAMPLE OF THIS PARTICULAR PROBLEM REVEALS ITSELF THROUGH THE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR). ALTHOUGH, IN MY OPINION, THE PROGRAM WAS ESTABLISHED TO HELP SMALL BUSINESSES TAKE GOVERNMENT RESEARCH AND DEVELOPMENT INTO THE COMMERCIAL MARKET, IT APPEARS THAT THE REAL PUSH IS TO EXTEND THE R&D LEG OF MOST AGENCIES.

MANY OF THE COMPANIES THAT ARE AWARDED PHASE ONE AND PHASE TWO GRANTS THROUGH THIS PROGRAM--SIMPLY COMPLETE THEIR RESEARCH AND THEN REAPPLY FOR A NEW PHASE ONE GRANT. IT IS CERTAINLY VALUABLE

TO HAVE SMALL COMPANIES INVOLVED IN THE RESEARCH AND DEVELOPMENT OF NEW TECHNOLOGY, BUT IF "TECHNOLOGY TRANSFER" IS GOING TO BE SUCCESSFUL, WE MUST IMPROVE ON THE NUMBER OF COMPANIES THAT ACTUALLY TAKE THEIR TECHNOLOGY BACK INTO THE FREE ENTERPRISE SYSTEM.

WE HAVE SO MANY PROGRAMS TO PROMOTE THE TRANSFER OF TECHNOLOGY--THAT IT IS HARD TO KEEP UP WITH ALL OF THEM. FOR THAT REASON, I PLAN TO CONTINUE MONITORING THE SBIR PROGRAM UNTIL I CAN SEE AN INCREASE IN THE NUMBER OF PHASE ONE AWARDS THAT ACTUALLY ENTER INTO PHASE THREE AND COMMERCIALIZATION.

I LOOK FORWARD TO THE TESTIMONY WE WILL HEAR TODAY AND HOPE THIS HEARING WILL HELP US DISCOVER MORE WAYS TO ASSIST SMALL BUSINESS AS THEY PARTICIPATE IN THE FREE ENTERPRISE USE OF NEW TECHNOLOGY.

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Senator BOSCHWITZ. Thank you very much.

Dr. Chen, would you repeat again how NIH seeks out the multitude of small, scientific firms that absolutely dot the landscape in my State and certainly in other States as well? Cardiac pacemakers began up in Minnesota through Medtronics and others. We have just developed a whole series, of companies that are involved in medical apparatuses that have a scientific element to them and other biotechology firms.

Could you state again, how the NIH seeks them out?

Dr. CHEN. I am familiar with Medtronics because the former chief of the Biomedical Engineering and Instrumentation Branch, when he left NIH some years ago, went to join that company.

I think that most companies engaged in biotechnology or in the biomedical field know of the NIH, and we have two major means of reaching them. One is to widely publicize the Annual Industry Collaboration Form, whose directory you are looking through right now, and this directory lists the names or our scientist that have expressed an interest in collaborating with industry, and also the names of companies that have made themselves known to us as interested in exploring collaborations with our scientists, so it is a process of advertising.

Senator BOSCHWITZ. I think that prior to beginning the questioning, we will complete the panel as has been suggested. Please proceed with testimony, Ms. McKinley.

STATEMENT OF TINA M. McKINLEY, OAK RIDGE ASSOCIATED UNIVERSITIES

Ms. MCKINLEY. Good morning, my name is Tina McKinley and I represent Oak Ridge Associated Universities. We are a consortium of 55 colleges and universities around the country, primarily in the southeast, and we are also a management and operating contractor with the Department of Energy.

This morning I would like to talk with you about one particular type of Technology Transfer, and that is the transfer of training technologies and resources from Federal facilities to small businesses.

In my written remarks, I also discuss a second dimension of what I call Training Technology Transfer, which is the training that needs to be provided to everyone involved in the transfer of technology tc ensure that it is a success. That is another dimension that has been discussed at some length this morning, particularly in Dr. Bromley's comments so I will not address this set of issues because we are short of time.

I would like to talk to you briefly about the Department of Energy system within which we work. We estimate that anywhere from 3 to 5 percent of its $17 billion operating budget is used to train employees. That translates into somewhere between $600 and $800 million a year to train about 110,000 to 140,000 scientists, engineers, technical personnel, and other workers.

For the past 12 years, my organization has managed a network for the Department of Energy that we call Training Resources and Data Exchange (TRADE). Within the TRADE network, there are more than 1,200 training personnel from 50 different DOE facili-

ties. The purpose of TRADE is to network. We provide a framework through which DOE facilities identify and exchange resources and training technologies. We also use a consensus-based process to develop generic materials that can then be used by individual facilities to add site-specific needs as they are identified.

Needless to say, we manage a lot of data through the TRADE network. We have an on-line database that describes close to 3,000 training programs that are being provided within DOE facilities to their employees. This does not include training programs that have been developed by colleges and universities nearby to meet specific needs. These are training programs that have been specifically developed to meet training requirements within the state-of-the-art facilities.

I serve as the chairman of the Member Services Committee for the Federal Laboratory Consortium for Technology Transfer. There is an agreement between the trade network that we manage for the DOE system, and the FLC, to identify and exchange training resources across the entire Federal system.

Now, within the last few years, we have been seeing small businesses begin to recognize the strength and vitality of training resources within the Federal facilities, particularly in the DOE system. If you go back to the original Pell bill in 1984, the intent was to try to provide training technologies to small businesses for them to be able to retrain their employees as needed.

But we are finding that small businesses are looking at these training resources for other reasons as well, and I would like to offer four recommendations that I would like you to consider to increase the connection between small businesses and their use of federally-developed training resources.

First of all, what do we mean when we talk about training technologies? In the Omnibus Trade Act, Section 6101, the Training Technology Transfer part, it specifies technologies such as computer-based training modules and interactive videodisc. Our experience has shown that there are a great many simplier training resources, such as the book that Dr. Chen just held up to you, that are potentially far more transferrable, far more quickly than computer-based training modules, for example, or interactive videodiscs.

I would like to suggest that we broaden our mindset when we talk about training technologies to include all of these resources and do whatever we can to try and increase the awareness about these resources and get them into the hands of small businesses and educational institutions.

Now, I know that everyone this morning has prided themselves on not asking for funding. What I would like to say, is that there is a mechanism already in place to identify the training resources that are being developed within Federal facilities; that is the clearinghouse that is to be maintained by NTIS under the Omnibus Trade Act.

NTIS is developing that clearinghouse, but at the present time, they are doing it without funding. I would like to encourage this Committee to consider doing what it can to get NTIS that funding so that we can establish the database that identifies and describes the training resources that are available in the Federal system.

With respect to CRDAs, I would like to ask you to consider encouraging those Agencies that sponsor contractor operated facilities, and of course in this instance, I refer particularly to the Department of Energy, to insert clauses in their management contracts which provide automatic copyrights to training materials that have been developed inhouse. The copyrights are really necessary because they provide a point of accountability and a place for updating information, and I would suggest that we encourage private entrepreneurs to use the NTIS clearinghouse to find out what resources are available and to work with contractor-operated facilities to obtain licenses to these copyrighted products, but that we also ask the entrepreneurs and other small businesses that, as they do so, to provide information back to the Federal system to let us know how these resources have been used so that we do not have a lot of duplication.

Finally, I would like to suggest that we consider asking Federal agencies and facilities to work together to define and develop generic training materials. This is particularly important because we have found that these resources, guides to good practice, for example, on-the-job checklists, curriculum guides, instructional materials, these documents, when they are developed in a generic fashion are almost immediately transferrable, and because they have been used by Federal facilities, they have in a sense been beta tested, and we suspect that they are going to be extremely commercializable.

I would suggest that you encourage Federal facilities and their laboratories to include educational institutions and small businesses in their planning activities as these generic training materials are defined and developed.

That is the extent of my remarks, gentlemen. I would be glad to answer any questions.

[The prepared statement of Ms. McKinley follows:]

TRAINING TECHNOLOGY TRANSFER: RESOURCES FOR SMALL BUSINESSES

Prepared for

U.S. Senate Committee
on Small Business

by

Tina M. McKinley
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, Tennessee 38731-0117

March 6, 1990

Good Morning. My name is Tina McKinley and I represent Oak Ridge Associated Universities, a consortium of 55 colleges and universities and a management and operating contractor with the Department of Energy.

This morning I would like to talk with you about one particular type of technology transfer, the transfer of training technologies from federal facilities to small businesses. In my written remarks I also discuss training as an integral component in the transfer of all technologies from federal facilities to the private sector.

Within the Department of Energy system, we estimate that anywhere from 3-5% of the operating budget of about $17 billion is spent to train employees; that translates into somewhere between $500 and $800 million. For the past twelve years, my organization has managed the TRADE (Training Resources and Data Exchange) network for DOE. The purpose of TRADE is to provide a framework within which more than 1500 training personnel from 50 DOE facilities across the country exchange training ideas, resources and data, develop generic training tools that are then tailored by individual DOE organizations to meet site needs and address a range of issues related to safe and competent worker performance.

We manage a lot of data describing training in the DOE system through TRADE. The generic training materials we develop through a consensus-building process appear to be commercially viable; we are presently working on developing a cooperative research and development agreement with an entrepreneur who proposes to combine some of these materials with a new technology he has patented.

We are seeing small businesses acknowledge the potential markets for designing, providing and evaluating worker training programs. I believe there are some things that could be done to encourage this further:

1. Broaden the mindset about technology transfer to include training resources such as curricula, instructor guides, and videotapes. These materials are commercially marketable in less time and tend to have broader application than computer-based training software and interactive videodisc.

2. Appropriate the funding authorized under the Trade Omnibus Act for the Training Technology Clearinghouse to be maintained by NTIS. Include information in the records that will help small businesses evaluate the applicability of the training resource to their own needs as well as its potential commercial value to others (for example, type of worker trained, type of resource involved, evaluation process, if any, and degree of site specific information included).

3. Encourage agencies sponsoring contractor-operated facilities to insert clauses in their management contracts providing automatic copyrights to training materials developed in-house. This provides a point of accountability and a focal point for updates and the creation of CRDAs with small businesses to make the packages marketable. Encourage private entrepreneurs to adapt noncopyrighted as well as copyrighted government training materials for use in other arenas. Allow the entrepreneurs to protect the modified work as proprietary, but require that they inform the NTIS clearinghouse about the new uses for the materials to avoid duplication.

4. Encourage federal agencies and facilities to work together to define and develop generic training packages. NTIS and the Office of Personnel Management, for example, are discussing this across federal agencies in the D.C. area. Participants in the TRADE network see this as a priority for the national DOE system. Include educational institutions and small businesses in the process to define priorities so that they are attuned to areas of greatest need.

A second dimension of Training Technology Transfer is the implementation of training as an integral part of the transfer process. There are roles here for small businesses to play, both as the users of federally developed technologies and as catalysts for the transfer of technologies to other users.

5. Recognize the importance of training as an integral part of the technology transfer process. Beginning with training laboratory personnel to think about additional uses of the technologies they are developing, through training potential users about new applications and ending with training workers in the manufacturing and production process, training emerges as a critical HOW that must accompany every technology WHAT being transferred.

6. Once recognized, training must be built into the transfer process. This means involving small businesses and educational institutions at the front end. Fundamental questions, such as WHO should be trained to perform WHAT and HOW best to implement that training, must be built into the business plan for the transfer.

7. Recent amendments to the Stevenson-Wydler Technology Innovation Act expand the ability of contractor-operated federal facilities to enter into Cooperative Research and Development Agreements (CRDAs). Executive Order 12591, and earlier amendments to the Act, authorized government-operated federal facilities to establish similar agreements. Encourage federal agencies and facilities to consider the development or modification of training as a focus for CRDAs or, at a minimum, a necessary part of CRDAs in areas of research likely to result in new worker training.

Training Technology Transfer: Resources for Small Businesses

Introduction

The definition of technology transfer has broadened significantly over the past twenty years. The initial concept of a transferable technology focused on tangible—and patentable—devices. Now, "technology" is generally considered to include ideas, information and knowledge and their applications in settings other than the original research environment. Ideas, knowledge and information are most frequently embodied in people and data. Transferring these technologies requires mechanisms different from patents. The ideas, knowledge and information developed within federal facilities can be used by small businesses in a number of ways from training employees to do their jobs to opening new markets.

As a consortium of 55 colleges and universities, Oak Ridge Associated Universities (ORAU) is dedicated to identifying problems and finding solutions in the fields of energy, health, environment, education and training. As a management and operating contractor for the U.S. Department of Energy, ORAU manages education and training programs designed to strengthen the national infrastructure needed for the research and implementation of energy technologies. One of the primary programs ORAU manages for the DOE is the Training Resources and Data Exchange (TRADE) network composed of training personnel from DOE facilities across the country. I serve as the Executive Director of TRADE. (For additional information about the TRADE network, see appendix I).

The American Society for Training and Development (ASTD) estimates that U.S. companies spend about $30 billion each year on formal training programs. This figure does not include the cost of wages for trainees. ASTD notes that an additional $180 billion is spent on informal training such as OJT. In comparison, the U.S. Department of Education expects that $199 billion will be spent this year on K-12 education with another $133 billion spent on higher education.

Within the Department of Energy system, we estimate that anywhere from 3-5% of the operating budget of about $17 billion is spent to train employees in the national DOE system; that translates into between $500 and $800 million. Can some portion of this investment be used by other sectors, including small businesses? As our country's service and information sectors begin to dominate, they bring with them increasing needs to train employees of all kinds to use technology and data safely and effectively. The training industry has seen tremendous growth over the past decade and will continue to grow to meet these demands in ways that educational systems cannot. Increasingly we are seeing small businesses acknowledge and reach for potential markets in designing, providing and assessing worker training.

The passage of the Federal Technology Transfer Act and, more recently, section 6101 of the 1988 Trade Bill have increased the attention paid to the transfer of federally developed training technologies within and from the federal laboratory system. Training texts, plans, curricula, resource guides, computer programs and similar resources developed by federal facilities to train personnel are being recognized as viable technologies which can be used by other federal laboratories, educational institutions and the private sector.

This Senate Committee addresses issues relevant to small business. Small business's critical importance to our country's well-being cannot be denied; it is, by definition, so varied and pervasive that mechanisms directed toward more homogeneous audiences (for example, school systems or state governments) do not produce the same results. My testimony will address the issues associated with developing training to support the technology transfer process and the transfer of training technologies as these concepts apply to small businesses in this country. I will briefly review some of the activities to date, summarize efforts presently in place and offer some ideas for implementing training

technology transfer further that are based on work ORAU, the Department of Energy, the National Technical Information Service, and the Federal Laboratory Consortium for Technology Transfer are presently engaged in. I will identify issues that we believe can lead to incentives and increased benefits to small businesses from the transfer of training technologies.

Definition of Terms

It is necessary to distinguish between two different dimensions of training technology transfer: training for the successful transfer of technology and the transfer of training technologies. These two components offer different opportunities for small businesses and use different mechanisms for implementation.

For purposes of these remarks, training is defined as the acquisition and transfer of site and job-specific skills and knowledge required by a worker to perform a job. The training may be provided in a classroom or on-the-job; regardless of the setting, the training requires the preparation of printed and audio-visual resources such as curricula, checklists, instructor guides and similar documents. Education, on the other hand, is defined to include all preparation a worker receives prior to beginning a job combined with whatever programs that individual enrolls in at an educational institution during the course of his or her career.

Training FOR Technology Transfer

In May 1988, the DOE Assistant Secretary for Defense Programs (DP) issued a DP Technology Utilization Initiative designed to allow the DOE defense complex to cooperate with the United States private sector to upgrade its competitiveness and productivity. This decision, made with the recognition that the defense complex has unique capabilities that can make significant contributions to U.S. economic security, provided yet another link in a growing chain of federal legislation, Presidential Orders, agency policies and numbers of studies directed toward increasing the commercialization of R&D funded through federal programs. Beginning with the Stevenson Wydler Act in 1980 (as amended in 1986 and 1989) and including the Bayh-Dole Act (1980, amended 1984), Congress has passed laws directing federal agencies and facilities to seek additional users for the results of their research. A constant theme has been the recognition that the transfer and widespread adoption of advanced technologies must be accompanied by the sharing of education and training programs so that new technology users can develop the skills and understanding needed to improve their productivity.

In 1985, the Federal Laboratory Consortium collected case study data from its member laboratories describing reasons (in the individual laboratory's estimation) for the successful transfer of three technologies over the lab's history. In one-third of the cases described (dating back two decades), the laboratory technology transfer personnel cited training as an important factor in the successful transfer of the technology.

Transferring Training Technologies

In 1984, the Training Technology Transfer Act proposed by Senator Pell noted that "the transfer of training technology to the private sector could properly augment existing Federal programs for the training of new industrial workers or the retraining of workers whose jobs have been disrupted." The bill noted further that the transfer of training technology to the private sector would be especially beneficial to small business concerns, which lack the resources to develop such technology independently.

The Pell bill, which is now included as Section 6101 et seq of the 1988 Trade Bill, establishes an Office of Training Technology Transfer within the U.S. Department of Education. This office will serve as the central broker between prospective users of federal training technologies and all federal agencies. Under contract to the Office, the National Technical Information Service will compile, update and distribute a government-wide inventory of training technologies. In keeping with the bill's original intent, the purpose of these activities is to provide small businesses with baseline data describing training resources that have been developed within federal facilities and are available for their internal use. As a number of us have looked at these resources, however, it has become increasingly clear that small businesses are also likely to be interested in these training materials because they may be commercially viable within a fairly short time frame (compared to "hard" technologies requiring patents).

One important trend must be acknowledged at this point. As the DOD and DOE systems have mandated that the training developed within their facilities must be systematically developed, so too have increasingly more companies in the private sector. Using systematic approaches to training development and implementation results in greater confidence in the training content and worth to the organization. A secondary result is the creation of well-defined written materials that may lend themselves more easily to use by external organizations. The importance of the implementation of systematic approaches to training and its ramifications for the transfer of training resources is addressed further in Appendix III.

Strategic Goals and Recommendations

The resources, expertise, technology and experience resident within federal research facilities can be used to increase the numbers of successful transfers of technologies to the private sector, to strengthen the capabilities of the U.S. educational system, to retrain industrial workers and to build businesses involved in the training industry. The training needs faced by state-of-the-art federal facilities, both in the communication of information about emerging technologies and in the performance of their missions, will ultimately be faced by other industries, particularly as the technologies being developed are adopted by the private sector. The growth of the training industry in this country will continue as a supplement to the national educational system. The goals for all dimensions of training technology transfer should be designed to optimize participation from small businesses (and schools and others as well) in finding and using federally developed training resources.

Training FOR Technology Transfer

1. GOAL: Define worker performance requirements associated with the technology to be transferred

   RECOMMENDATION: Encourage federal facilities to define the skills and knowledge needed to understand the technology and, most importantly, to apply it in new settings. Involve the researchers, the federal facility training personnel and the technology transfer staff in analyzing what is needed to be able to use the technology in new applications.

2. GOAL: Design training to support the transfer of the technology

   RECOMMENDATION: Recognize the importance of training as an integral part of the technology transfer process. Beginning with training laboratory personnel to think about additional uses of the technologies they are developing, through training potential users about new applications and ending with training workers in the manufacturing and production process, training emerges as a critical HOW that must accompany every technology WHAT being transferred.

3. GOAL: Implement training as part of the transfer process

   RECOMMENDATION: Once recognized, training must be built into the transfer process. This means involving small businesses and educational institutions at the front end. Ultimately, the training should be measured by each worker's demonstrable performance so that the training contributes to best adoption and use of the transferred technology. Fundamental questions such as WHO should be trained to perform WHAT and HOW best to implement that training must be built into the business plan for the transfer.

4. GOAL: Provide more training for identifying and obtaining federal technologies to small businesses

   RECOMMENDATION: Strengthen the communication channels between federal facilities and small businesses. This means training potential small business users, as well as expanded outreach programs. Tailor the training so that it is targeted toward organizations that have limited staff, time and funding.

Transferring Training Technologies

5. GOAL: Acknowledge training resources as viable resources for transfer

   RECOMMENDATION: Increase current visibility for the Training Technology Transfer component of the 1988 Omnibus Trade act, but broaden the mindset about training technologies to include written resources such as curricula and instructor guides as well as videotapes and other training tools. These materials are commercially marketable

in less time and tend to have broader application than computer-based training software and interactive videodisc.

6. GOAL: Characterize training resources available for transfer in a manner usable by small businesses and the educational system

   RECOMMENDATION: Encourage federal agencies and facilities to work together to define and develop generic training packages. NTIS and the Office of Personnel Management, for example, are discussing this across federal agencies in the D.C. area. The TRADE network perceives this as a priority for the national DOE system. Include educational institutions and small businesses in the process to define priorities so that they are attuned to areas of greatest need. The creation and use of generic training materials by federal facilities essentially provides small businesses and other new users with resources that have been "beta tested" by the federal system.

   RECOMMENDATION: Appropriate the funding authorized under the Trade Omnibus Act for the Training Technology Clearinghouse to be maintained by NTIS. Include information in the records that will help small businesses evaluate the applicability of the training resource to their own needs as well as its potential commercial value to others (for example: type of worker trained; type of resource involved; evaluation process, if any; and degree of site specific information included).

7. GOAL: Provide mechanisms through which small businesses can obtain federally developed training resources

   RECOMMENDATION: Recent amendments to section 12 of the Stevenson-Wydler Technology Innovation Act of 1980 expand the ability to enter into Cooperative Research and Development Agreements (CRDAs) to contractor-operated federal facilities. Executive Order 12591, and earlier amendments to the Act, authorized government-operated federal facilities to establish similar agreements. Encourage federal agencies and facilities to consider the development or modification of training as a focus for CRDAs or, at a minimum, a necessary part of CRDAs in areas of research likely to result in new worker training.

   RECOMMENDATION: Encourage agencies sponsoring contractor-operated facilities to insert clauses in their management contracts providing automatic copyrights to training materials developed in-house. This provides a point of accountability and a focal point for updates as well as the creation of CRDAs with small businesses to make the packages marketable. Encourage private entrepreneurs to adapt noncopyrighted as well as copyrighted government training materials for use in other arenas. Allow the entrepreneurs to protect the modified work as proprietary, but require that they inform the NTIS clearinghouse about the new uses for the materials to avoid duplication.

Current Efforts

Training FOR Technology Transfer

The U.S. spends more money in support of research and development than any other country. Almost 70% of the R&D dollars support military research which has resulted in limited commercial benefit. Mission-essential R&D has helped to solve some public and private sector needs; by and large, this assistance has emerged through secondary application of technologies developed for federal agency responsibilities. Until the early 1980s, significant active transfer of federally-developed technologies occurred only sporadically. Within the past ten years, however, the consensus has evolved that more widespread use of federally funded R&D technologies and knowledge is a key element in strengthening U.S. productivity and ability to remain competitive in global markets.

The Federal Laboratory Consortium for Technology Transfer (FLC) was organized in 1974 and formally chartered by the Federal Technology Transfer Act of 1986 to promote and strengthen technology transfer across the federal research system. FLC members include all major federal laboratories, research centers and their parent agencies. The FLC is a service organization providing a basic link between its individual laboratory members and potential users of government developed technologies. One of the lessons learned over the FLC's history is that the network is most effective when requests identify a specific problem or need and the followup involves direct personal contact. This lesson has proved particularly

salient for small business. Recently, the FLC signed a plan for cooperation with the National Institute for Standards and Technology. The plan is specifically designed to "provide technical assistance to State technology programs, to help those programs help business, particularly small and medium-sized business, to enhance their competitiveness through the application of science and technology." For more information about the FLC and its current efforts in training for technology transfer, see Appendix II.

Within the DOE system, the DOE Superconductivity Centers are working with small businesses as well as local educational institutions to identify the skills and knowledge that will be needed in the manufacturing processes for superconductor applications. This is also evident in the recent DOE five-year plan for environmental restoration and waste management; a portion of the plan describes the need to work with the educational and private sectors to develop and implement training programs for workers who will be involved in the cleanup activities.

As recipients of federal technologies, suppliers to recipients of federal technologies or providers of technical support to large industry and the educational system, small business can play a vitally important role in the implementation of training for technology transfer.

Transferring Training Technologies

The transfer of training technologies has two factors that can make it particularly successful: 1) the potential for leveraging resources and 2) a built-in multiplier effect. Both are based on the effort invested in education and training nationwide. By working with the educational system and the business community, federal facilities can build upon a wealth of resources. Educational facilities are, by definition, multipliers. They exist to develop and impart knowledge to students and staff. Transfers of expertise, resources and knowledge to schools ensure that these capabilities will be spread as far and wide as possible. Ultimately, the transfer of training resources must be completed to the industrial sector to provide the calibre of workers needed in a society wrestling with the effective incorporation of advanced technologies.

Technology transfer personnel at federal facilities will recognize in-house training resources as viable for transfer if the concept is supported by the parent agency. Training personnel within these same facilities want their resources and programs used by as many learners and organizations as possible if they can be provided some release from staff support responsibilities in their own facilities. Small businesses need to be able to identify emerging technologies accompanied by new skill needs and to understand how federal facilities are addressing these needs in-house.

The value of a training program to a DOE facility is measured by its ability to improve worker performance on the job. The resources, expertise and training strategy developed by a federal facility could prove useful to a small business to the extent that it wants its employees to demonstrate a similar level of performance, or at a minimum, knowledge about complex facilities.

In a recent hearing before the House Committee on Small Business, several speakers noted that businesses want access to existing off-the-shelf technology rather than state-of-the-art because it is commercially more viable. This applies to training resources as well as other types of technologies. Given that most federal agencies are directing their training efforts into performance-based results, the likelihood that training resources can be applied in other arenas increases (at least it is much easier to assess).

In their 1987 Report to Congress on the "Feasibility and Cost of a Current and Comprehensive Inventory of Federally Developed Training Software", the NTIS stated that its basic concern is to inventory all federally developed training material with potential application in non-federal sectors. Within its existing authority, NTIS has established a product line of federally developed training materials. In fact, development of the listing is taking place through the creation of a joint venture between NTIS and a small business located in New York. NTIS is undertaking these efforts despite the fact that Congress authorized but never appropriated funding for the compilation of this information. As the listings of training resources developed within federal facilities expands, we expect to see increasingly more performance-based training materials included.

One of the primary functions we manage through the TRADE network is the identification of generic components of critical training needs and, using a consensus-building process, development and distribution of training tools that can be used by a range of DOE facilities. Each facility subsequently adds site specific information to the training resources to make them directly applicable to its own needs. There are three aspects of this process which can result in transfer outside the DOE system. The first is the actual transfer of training resources which contain generic materials. At the present time we are seeking copyright to a number of these generic packages so that they can be made available to external users. We seek the copyrights because we want to ensure that the products are updated on a regular basis and modified to reflect new training requirements (many of our efforts are presently directed toward compliance training in the areas of environment, safety and health). We are also working on establishing a cooperative research and development agreement with an entrepreneur who is seeking the license to some of these copyrights.

Secondly, the site specific training materials developed by an individual facility may be transferable. These resources may be valuable if an educational facility or business close to a federal installation can be directly involved in preparing workers for jobs within that installation. This type of transfer encourages the schools, businesses and DOE facilities to work together to develop worker skill and knowledge needs present (and anticipated) in the local job market.

The third transferable component is the process of analyzing jobs for the skills, knowledge and abilities needed to perform them and developing tools which can be used to prepare workers. Educational institutions and training firms are likely to be interested in learning from the process of assessing and responding to training needs in DOE facilities. This is particularly important as systematic approaches to training become the primary modes of operation; it is also an essential prerequisite for the creation of applications using advanced training technologies.

Summary

The legislative framework is in place to expand both dimensions of training technology transfer beyond present efforts. Immediate needs focus on extending the outreach from federal facilities to small business, through various agents such as state offices and others, beyond information dissemination to active training. Baseline data are slowly being compiled to identify what training resources exist within the federal system and how the private sector may be able to gain from new uses for these resources. Mechanisms such as CRDAs and copyrights on training materials are being implemented by federal facilities to strengthen interaction with the private and educational sectors. By recognizing the potential for strengthening small businesses and encouraging new markets, the Senate Committee on Small Business can directly encourage federal agencies, facilities, and the small business sector to optimize the lessons being learned in transferring and using new technologies!

Appendix I:

The DOE TRADE Network and Training Technology Transfer

Training Resources and Data Exchange (TRADE) is a network of DOE and contractor training personnel from more than 50 DOE facilities formed to increase the exchange of ideas, information and resources in training and development across the national DOE system. Eight DOE program offices support a range of activities in training areas related to safeguards and security, environmental management, radiation protection, industrial hygiene, emergency preparedness, human resource issues, security education and the use of advanced training technologies.

TRADE has been managed by Oak Ridge Associated Universities since the network was created in 1978. An Executive Committee of training managers from ten DOE facilities provides leadership for TRADE activities; program managers from sponsoring DOE offices serve on the DOE Advisory Committee. Through the formation of Special Interest Groups, a range of training tools have been created to meet the needs of training personnel in the DOE system. Resource Guides, Guides to Good Practice, analyses of new training technologies, glossaries, generic training packages, bibliographies and an online bulletin board have all been developed for use by DOE facilities.

ORAU manages several large data bases for use by the TRADE network including the TRD File which describes close to 3000 training programs in professional, technical, scientific and craft areas provided by DOE facilities to employees. As DOE evolves new technology transfer policies for agency and contractor implementation, procedures and mechanisms for accessing the resources available through the TRADE network will be established.

For more information about TRADE, contact Tina McKinley, Oak Ridge Associated Universities, (615) 576-3418.

Appendix II:

The FLC and Training Technology Transfer

The Federal Laboratory Consortium (FLC) for Technology Transfer was formally chartered by the Federal Technology Transfer Act of 1986. It has, however, been in existence for almost twenty years. The FLC's mission is to promote the rapid movement of Federal laboratory research results and technologies into the mainstream of the U.S. economy. The mission is met through a coordinated program that supports the technology transfer needs of member laboratories and agencies as well as their public and private sector collaborators.

In the FLC 1989 Report to Congress, Chairman Dr. Loren Schmid noted that current programmatic emphases have been to provide opportunities for person-to-person cooperation across the federal and private sectors, to increase outreach to small business, to strengthen FLC regional operations and to increase training opportunities for federal laboratory technology transfer staff.

Through its recent plan of cooperation with NIST, the FLC will host a series of workshops this Spring to train technology agents from states, community colleges and other organizations to aid small business by accessing federal technologies in areas that have been rated as highest priority (for example, environmental pollution and control as it relates to agriculture and material sciences with an emphasis in metals and ceramics). Part of each workshop will involve a day-long training session designed to increase each participant's understanding of how to contact federal laboratories, find whether the desired technologies exist and, if so, obtain them.

Another FLC activity known as LABLINK will electronically hook up small businesses at participating incubators and technology business parks throughout the Northeast and Middle Atlantic regions to federal research laboratories in the same geographic area. The objectives are to enable small businesses to find sources of technical support at the labs and universities for specific needs, provide labs and universities with an outlet for announcing new opportunities to small business and encouraging discussion between small businesses with technical needs and labs and universities with technical capabilities. As with all FLC activities, this effort, if proven successful, will be duplicated across additional regions.

For more information about the FLC, contact the FLC Administrator's Office, (206) 683-1005.

Appendix III:

Systematic Approaches to Training and Training Technology Transfer

The distinction between education programs designed to provide a broad understanding of fundamental principles and job-specific training tailored to ensure that the worker performs in a competent and safe manner is one of the primary underpinnings of recent growth in the private training industry. The Department of Defense, Internal Revenue Service and Federal Aviation Administration as well as IBM, Motorola and Federal Express have all formally adopted systematic approaches to identifying worker performance problems that define what can be resolved through training (versus other solutions).

On another front, the development of training according to law and policy requirements, particularly in the federal sector where a large number of workers require compliance training, results in the identification and creation of generic training that can meet requirements for large and small businesses. This training is designed to impact worker performance; evaluation of the success of this training is driven by the evolution of measurable performance requirements.

Together, new compliance requirements and a technology-driven work environment escalate the amount of training that must be designed and delivered. Public and private sectors alike seek ways to reduce worker time in training and greater flexibility in scheduling. So long as the economy of scale allows it, the result is an increased use of advanced (electronic) training technologies. This evolution is fairly new in comparison with other industrial sectors. As Ray Fox, President of the Society for Applied Learning Technology, noted recently, "While the first stand-alone microcomputer system based interactive video system was patented in 1976 and the first interactive videodiscs systems were publicly demonstrated in 1979, a viable industry supplying off-the-shelf technology has been in being for less than a decade." Even if the economy of scale does not provide for the use of advanced technologies, the resources developed for training purposes lend themselves to new uses in similar settings.

More and more entrepreneurs are beginning to look toward federal facilities for resources that can be modified to be commercially viable in this emerging training market. The initial emphasis on advanced technologies has broadened to include all types of systematically-developed training tools that, with minor modification, may be usable to schools and businesses of all types.

Senator BOSCHWITZ. Thank you.

Now we will turn to Dr. Johnson or are you just accompanying Mr. Mercer?

Dr. JOHNSON. Yes, sir, I am prepared to answer your questions, but I did not come with remarks.

Senator BOSCHWITZ. Senator.

Senator BUMPERS. I just have one question of Dr. Johnson. Dr. Johnson, how is the implementation of the Technology Transfer Extension Program going?

Dr. JOHNSON. Well, sir, it is going quite well. I believe we have made significant progress. As you know, we have had appropriated to us this year about $1.3 million, and with those resources we will soon be calling for proposals for a Small Grants Program that is called for under the Omnibus Trade Bill. About $900,000 of the appropriated funds will be used for the Grants Program. Two different kinds of grants will be available, primarily to State and local governments.

In one area, grants will be available for innovative new ways of demonstrating the transfer of Federal technology, a subject we have been talking about here earlier, to the local economy. And there what we have in mind would be such things as new ways of coupling Federal laboratories to economic development programs in the State, perhaps activities such as stimulation of incubators to incubate technology from Federal laboratories and the like—a whole host of different possibilities. We will be calling for proposals very soon in that.

The other area where we will have some grant money available will be for stimulating or catalyzing the establishment of new extension outreach activities in areas of the country where they do not now exist. And in both cases, the intent is that this will be modest amounts of money, perhaps $50,000 to $100,000 size grants, and that they will be matched by State funds or local funds. Our intent is to try to catalyze and stimulate and to encourage these kinds of activities with the modest amount of funds that we have.

The other part of the appropriation, the remaining $400,000, we are using for staff and administrative purposes, and we have already carried out workshops in four States on a pilot basis; we will be doing four more during this fiscal year. And those workshops are training workshops for extension providers.

A typical example is a workshop we held in Oklahoma during this past year. We worked with the vocational education people in the State of Oklahoma, brought together all of the extension providers from all of the extension outreach programs that operate within the State—independent of how they are financed, independent of whether they are financed by State funds or Federal funds or some combination of State, Federal and private—and we provided a day-long training session for them to help them understand better the various programs that are operating in their own States so that they could cross-refer industrial, small business customers to other programs and other services.

We also introduced them to the standard measurement services, calibration services, reference materials and other services that NIST offers, when it is appropriate to use them, how they can be used, how they can be accessed by their small business clients. And

then we introduced them to Federal laboratories in their own areas and how they might access Federal technology. We are planning this year four more of those workshops.

Senator BUMPERS. That is a lot for $1.3 million, is it not?

Dr. JOHNSON. I think we are stretching the funds as much as we can, sir.

Senator BUMPERS. Dr. Chen, when somebody invents a vaccine or any biotechnological development, that is patentable, is it not?

Dr. CHEN. It probably is.

Senator BUMPERS. Do you have any idea how many biotechnology patents were issued by the United States Patent Office last year?

Dr. CHEN. I think I have seen a number, but I cannot recall it.

Senator BUMPERS. Do you have any idea how many were American and how many were Japanese?

Dr. CHEN. I am sorry.

Senator BUMPERS. Well, do you know whether they had more than we did or not? You do not know that either?

Dr. CHEN. I do not know.

Senator BUMPERS. That is all, Mr. Chairman.

Senator BOSCHWITZ. Senator Wallop.

Senator WALLOP. Mr. Chairman, I will not take much time of the Committee or the panel.

I want to tip my hat to you, Ms. McKinley, for your four suggestions.

Ms. MCKINLEY. Thank you, sir.

Senator WALLOP. The problem is really very simple. We who are in the Government, for whatever posture we hold in it, do not have any idea how big it is to the rest of the world. It seems understandable because it is reasonably familiar, even to those of us who are awed by it, being familiar with it. But outside of here, it is terrific and it is intimidating, and a lot of people simply do not know.

I was interested, Mr. Chen, that everybody in the business knows that you exist. Let me assure you that everybody in the business may know you exist but do not know that things are available to you. So, these outreach programs, I think, are really astonishingly important.

And the other thing, it seems to me we need, and I would ask anybody to comment on, sometimes we have a program that is set up to encourage, expand, develop inventions in one level of the world that belongs to the particular Agency involved.

Take Energy, and so you have somebody come with an idea that he thinks is Energy-related and Energy decides it is not entirely Energy-related, not maybe perhaps enough Energy-related. And we have no means of handing off—I mean no really solid means of handing off so that it might go to Commerce or DOD or some other place intelligent for the rest of the Government's assistance in expanding that idea.

Ms. MCKINLEY. If I may comment on that, sir, the Federal Lab Consortium does, in fact, have a network of representatives from 300 of the 762 laboratories that Dr. Bromley referred to earlier this morning. As members of that consortium, in addition to on-line, 24-hour E mail and a central clearinghouse, we routinely post inquiries that come in to any of the Federal labs so that all of the tech-

nology transfer officers at all 300 of the participating laboratories can and do respond.

I agree, sir, that is it exceedingly difficult, even so, to try to address the needs of small businesses because of their diversity and because they just do not have the skills and technological base that the larger businesses do, but there are networks out there and we are trying to get the Outreach Programs going. Perhaps we need, somehow, to know more about what small businesses need in order to be able to tailor our Outreach Program somewhat differently.

Senator WALLOP. Actually, you will hear, should you be able to stay, one of the types of complications from Mac Bryant from Wyoming. Wyoming has gotten to the status under NIST to be a mentor State, but the downside of that is that some of these energy-related inventions are short funded. I think $150,000 out of $900,000 goes toward developing those.

And it mostly ends out that not so much that these are coming from the national labs, these are coming from sort of domestic ideas and small business, and the program that is designed to have them blossom is a good one, but if it does not quite fit, then it is hard to find the appropriate fertilizer to make it blossom further. And we need to find a way to do that.

I just would say, Mr. Chairman, one of the interesting things is that we may be frustrated somewhat by the pace at which these programs go, but when you see what they have accomplished during the length of time that they have been in existence, the pace is perhaps better than we give it credit for being. And I think part of the ingenuity of the people here at this table and others that have testified before us is accountable for that.

And the only thing that I would say is please, for heaven sake, try to view it from below as you search for how to make it better, because from below it still looks awfully impenetrable and awfully far away.

Dr. CHEN. Senator Wallop, what we are trying to do at the NIH is sensitize the industrial community that there is a single focal point at the NIH for Technology Transfer. That is namely the Office of Technology Transfer, and a single phone call will get you into one of our staff there or, shortly, into the electronic bulletin board.

Senator WALLOP. Thank you.

Dr. JOHNSON. If I could comment, if I may. Our experience at NIST over the past year in working with extension activities around the country is that, first of all, there is certainly a very large number of small businesses out there to reach and that perhaps the best approach to them is through the existing network of extension activities, and that is why we are involved in these training activities. Small Business Development Centers, for example, as you have in your State, Mr. Wallop, are very effective in reaching small businesses and in fact deal with large numbers of small businesses on a daily basis.

Our feeling is that they need better information on how to refer those small business clients, where to refer them in Government, how to make the right 'connections. There are a lot of resources available in Government, and I think that it is a matter of making the connection between those resources and the small businesses.

Perhaps the whole network of extension activities that is already out there is really the key and we need to couple better existing Federal resources to that network.

In that vein, I would follow up on a comment that Tina made a few moments ago. We have just consummated at NIST an agreement with the Federal Laboratory Consortium to work very directly with them in our efforts with Small Business Extension Programs around the country and help couple the resources of the Federal Lab Consortia into the small businesses. I think that is going to work very well.

Senator WALLOP. Thank you. Thank you Mr. Chairman. Things are going.

Senator BOSCHWITZ. I would ask the panel if each would briefly answer whether or not you seek out small business—or make your facilities known perhaps is a better way of expressing it—to small business organizations, be it the National Federation of Independent Business or be it an association of various types of businesses that you feel might be interested in some of the patents that appear in this book or in other places. That is, if patents apply to a specific industry, do you go to that industry or to the trade organizations in that industry to make them aware of the patents?

I would ask that of, first, Mr. Mercer and Mr. Johnson next.

Mr. MERCER. The answer is yes. Can we do it better? Yes, we can. A specific goal of the Commerce Department as a whole and the Technology Administration in particular is to identify its clients—and certainly the client base is small business in many respects, certainly here—and to contact them better to find out how we can service them better. And this has the direct support of Secretary Mosbacher and Deputy Secretary Mullen as part of their quality initiative of know your client and know how to serve him better.

Ms. MCKINLEY. With respect to the training world, the Department of Energy network that we manage has agreements with professional networks, such as the Society for Applied Learning Technology, the National Society for Performance and Instruction, and the American Society for Training and Development. We find this to be a most effective way to access the training industry.

Are we actively transferring those training materials at the present time? We are beginning to. As I remarked earlier, what we first of all have to do is to get the mindset within the Federal agencies and the facilities to the point where these resources are recognized as valuable resources for transfer, and we are beginning to make that happen. We hope to have our first CRADA in place to transfer some of these generic training resources within the next several months.

Senator BOSCHWITZ. How do you seek out the other parts of the scientific community that would be interested? Do you wait for them to come to you, Dr. Chen, or do you actively seek them out?

Dr. CHEN. Well, up to the present, we have dealt primarily with organizations in the pharmaceutical and biotechnology areas rather than small businesses generally, so that we have sort of targeted at the industries that we have had relationships with in the past or that we think will be interested in the types of research that we do. And we have had ongoing dialogue with a number of

these organizations, invite them to use their mailing lists to announce our forum.

Senator BOSCHWITZ. You do use the organizations' mailing lists to announce your forum?

Dr. CHEN. We have given them announcements to put in their newsletters, and they have announced it. For example, the forum was announced through many of these.

Senator BOSCHWITZ. How many people were at that forum?

Dr. CHEN. Well, the first one had about 250 to 300, and then there were between 150 and 200 at the second one in 1989.

Senator BOSCHWITZ. I suggest that you all do need to seek out the organizations that in turn can multiply your efforts. Small businesses are not likely, on their own, to come to you unless they are somehow alerted. I hope you are seeking out the various ways to alert them so you can spread your wings.

Thank you very much. It has been a good panel.

And now we will turn to our final panel, Mr. Bill Rader, Joseph Shuster and Mr. McCray Bryant.

Both Senator Wallop and I are being pushed for time, and so we would ask that each one of you please summarize your testimony and be as direct as possible in informing the committee. The entirety of your written testimony will be made part of the record.

Let us start with you, Mr. Shuster, if you will.

STATEMENT OF JOSEPH M. SHUSTER, PRESIDENT, TELTECH, INC.

Mr. SHUSTER. Mr. Chairman, Senator and colleagues, thank you for inviting me to be with you today and for the opportunity to lend our experience in Technology Transfer to formulation of the proposed National Technical Extension Service, which I would like to have included in the record, along with these remarks.

Technology Transfer is a very popular topic these days, both here in Washington and in the halls of our State office buildings. Many in this room have expressed particular concern about the need for better Technology Transfer from Government and academia to industry.

Arguments in support of this position are very compelling. A recent estimate suggests, for instance, that the economic future of our country is 70 percent dependent on technology. Even the competitively critical area of productivity enhancement is 60 percent determined by technology.

Our experience in the design and implementation of a successful Technology Transfer system has shown that American universities and national laboratories are virtual hothouses of ideas and technology. However, far too much of the technology and the know-how—particularly, perhaps, the know-how behind it—just sits on the shelf.

As Dr. Bromley said, the problems is very complex because effective Technology Transfer requires a change in culture for most American companies. Not only are existing programs out of step with the need, but the intended recipient is also a very reluctant partner.

Unlike Germany or Japan, our corporate managers look inward, rather than outward for technical solutions. In hiding behind pro-

prietary issues, American industry simply reinforces its parochial bias. Further testimony to this sad situation is the fact that most technical professionals in this country cannot even name our major national laboratories, much less know what is going on inside of them.

Widespread support for the development of an effective Technology Transfer method is clearly in evidence. There are 22 States presently that have what they refer to as Technology Transfer Programs. Within the framework of our Federal Government, a range of organizations have Technology Transfer, as all, or part of the mission.

But even though one could argue that all of the existing efforts at Technology Transfer have done some good, none of them, either singularly or collectively, are getting the job done. The reasons vary. Among them are incomplete service capabilities, lack of grassroots awareness or support, inability to deliver needed information with required timeliness and, most importantly, failure to fit their access systems to the daily needs of the industrial technical professional.

As a result, with the possible exception of military spending, America is getting a lousy bang from the federally funded research buck. If Americans cannot reap the fruits of Federal research, why should such programs even exist?

The good news is that once a company, large or small, is given access to a Technical Outreach Program that is truly in tune with its needs and sensitivities, it will take to the program with a vengeance and almost invariably its employees will come to the surprising realization that experts and knowledge outside their own organization can become a powerful ally in their quest for better and more competitive products.

It is now not only a question of where and how much we should continue to spend on research but also a question of how to incorporate this research into our economy. The proposed National Technical Extension Program is tailored to the information needs of American industry. It outlines how the Federal Government can organize and then make available to every user its vast technical resources. It explains how each State can easily plug into these resources to enhance and complete their own programs.

Based on our experience, we offer the following:

No. 1, the building of technical centers while affording some benefits is an obsolete concept. In fact, present-day computer and telecommunications technology enables us to turn every technical professional in the country into a technical center.

No. 2. The Federal Government must, in a comprehensive, standardized way, catalogue their intellectual property and ongoing research and make this information available on-line to every technical professional in the country.

No. 3. An effective Technology Transfer Program must encompass direct access to the world's technical literature as well as to America's best technical minds. Federal technical experts should be included in the system and should be paid for their participation. And the system should be delivered in a way that industry wants it, not in a way, perhaps, that some agency thinks it should be delivered.

No. 4. Technology Transfer must be a grassroots direct to the user program, with no or few intermediaries. Technology should be brought directly to people making the day-to-day technical decisions.

No. 5. Medium and large companies will pay for access to the proposed service.

No. 6. Entrepreneurs, start up and small companies, particularly those that are rural are least likely to have access to such a service. While they create the most jobs, are most risk oriented, move faster and have the greatest need for such a program, they are least able to pay.

No. 7. To our knowledge, the proposed program represents the first time in history that rural and small companies could have the same access to information and knowledge as do the Nation's largest corporations.

We are convinced that American small business will be critical to our country's technical resurgence. We are equally certain that they will fulfill this role only if there is an improved partnership between industry, academia and Government.

We propose, therefore, that the National Technical Extension Service be offered nationwide without charge to start-ups and small companies. The service should also be made available to larger companies, but payment should be required.

The proposed National Technical Extension Service does not have to be researched since a model is already working on a national scale. Therefore, adoption of such a program represents minimum risks. I personally do not know of any program that can offer the kind of quantum benefit to the country that a sound Technical Extension Service can provide.

A number of independent studies suggest that the proposed program will yield a return on investment ratio of at least 20 to 1. Our own experience indicates returns in excess of 20 to 1—30 plus to 1 is more likely. America's attempts at realizing the full economic benefit of this technology investment has thus far proven tragically inadequate.

I concur with Dr. Bromley when he said, and I am paraphrasing him, "I believe that we are at a pivotal point in the history of Technology Transfer in America." We have a process that will work. Any further delay just does not make sense.

That is the end of my presentation, but I would like to comment, if I may, on some things that I have heard earlier.

[Document and questions and answers follow:]

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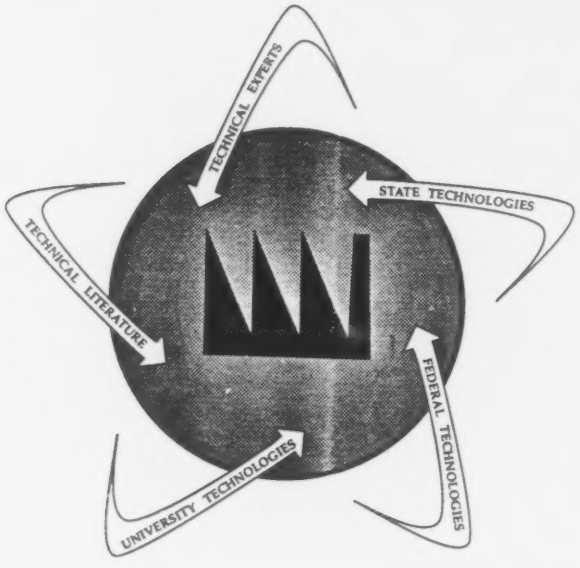
National Technical Extension Service



Ten Year Phased Program

NATIONAL TECHNICAL EXTENSION

INTRODUCTION

There is a growing consensus on the national level that quick and efficient access to needed information and to state and federal programs and services by all companies-- regardless of size or location– is no longer a luxury, but a basic competitive tool. This statement is most true in technology, where useful life cycles are becoming shorter and shorter. Perhaps Japan, more than any other nation in the world, exemplifies how fast moving technologies can be exploited. While the Japanese certainly have not developed the most, or even the best technology, they have succeeded in evolving the most effective system of locating and accessing technology wherever it is in the world. And their ability to apply such technology once it has been captured has enabled them to outstrip their competitors in many important industries.

It is predicted that the economic future of the U.S. is 70% dependent upon technology. Even the competitively critical area of productivity enhancement is 60% determined by technical developments[1]. The U.S. Congress has responded. Both Senator Hollings (SC) and Representative Boehlert (NY) have introduced bills designed to encourage technology transfer programs. This legislation was part of the recent trade bill.

The models referenced in discussions about how needed information and technology can be provided to industry are typically the state Agriculture Extension Services which have served the agricultural industry so well for so many years. The powerful impact of their program has amounted to the revolutionizing of the U.S. economy. Agricultural Extension was the infra-structure that gave America the capacity to effectively ***share*** the Country's best agricultural information and knowledge. Their programs have also demonstrated the efficacy of a direct, hands-on, grass roots approach to knowledge transfer.

Teltech, in response to a request from Senator Boschwitz's office, has prepared the accompanying ten-year phased program for development of a National Technical Extension Service. The extension system proposed herein, complete with cost estimates, is based on Teltech's successful experience in technology transfer program implementation. If developed, the proposed system will serve the technical information and technology transfer needs of the entire country now, and well into the future.

[1] Productivity Center IIT Research Center - Keith McKee

The cost of developing the critical components of the proposed system (e.g., assembling of databases, providing the service directly to qualifying companies, establishment of public access points) is estimated at $34 million the first year, with $18 million of that total to be supplied at the federal level. Ten years following its introduction, roll-out of the service to all fifty states is slated to be complete. At that time, costs will stabilize at approximately $190 million per year, the federal government assuming a $90 million share and the states shouldering the remainder.[2] Assumptions underlying these estimates are noted in the body of this proposal.

The United States still produces more technology than any other country. But federal technology resources, despite their remarkable potential for impacting the nation's enterprise, are rarely accessed by American companies. The reason: no convenient technology transfer mechanism exists. The proposed program will help focus these resources where they are most needed, (i.e., creating job opportunities and enhancing the economic future of the country). Peter Drucker, the management guru, says that ***"knowledge is now the central capital, the cost center, and the crucial resource of our economy."***

A great deal of money has been spent on technology transfer at the federal and state levels. Unfortunately, most of these programs have met with limited success. Characteristically, such efforts have been under-funded, under-marketed, and simply not designed to fit into the day-to-day life of a technical professional. The sad result of these failed attempts is that, while some foreigners take great advantage of our publicly supported research, most American scientists and engineers don't even know where major national labs are located, much less their potential value as sources of new products, new technologies and critical technical assistance

American technical extension or technology transfer will be as good as it can be only when every scientist, engineer or person in the country who needs technical information or knowledge can access it conveniently right from his or her own desk. Computers and telecommunication make this possible now.

A quotation from American Nobelist Robert Solow has more meaning today than ever before: ***"Innovation, rather than capital, is the prime source of economic growth. Countries grow rich, not because they have more money to invest, but because they have more and better ideas."***

The estimated time required to completely implement this phased program nationwide is 10 years. With an expected payback of 10-20 to 1[3], it seems that it is about time to get on with it.

[2] Costs decline as some companies "sunset" out of the program.
[3] ACARD Study - DOE, DOD (1985), PENNTAP.

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OBJECTIVES

It is clear that the next twenty years, both in the United States and abroad, will be marked by the growth of knowledge- and technology-intensive industries. Will the United States be the leader in this growth? Can America provide the innovative technologies and services required to increase national productivity, while also expanding employment opportunities? Achievement of the following objectives will establish a firm foundation for a National Technical Extension Service, and satisfy American industry's growing and competitive need for accurate, reliable and timely technical information and knowledge.

1. To provide a cooperative federal-state knowledge and technology extension service to American industry. The federal government will make their technology and other services quickly and conveniently accessible through state administered programs that will also provide for in-state technical extension services.

2. To provide all start-up and small[1] companies--including those in rural locations--with free, quick and convenient access to the information and knowledge they need to grow and prosper. The Department of Commerce, Department of Energy, Department of Defense, National Institute of Health, Small Business Administration, NASA, the National Laboratories and other agencies have knowledge and technology that is vital to such small businesses.

3. To bring to each start-up and small company quick and convenient access to all federal and state services and programs, particularly those that were established specifically for them.

4. To bring to each start-up and small company quick and convenient access to the nation's technology, as well as to national and state technical experts.

5. To provide each system user access to published technical and business information worldwide, through interactive remote literature searching.

6. To provide satisfactory response to virtually any technical or marketing inquiry whatsoever, so long as such information resides in the public domain.

7. To provide a single, integrated service which can be accessed through any PC.

8. To provide companies with training in the use of the service.

9. To provide a follow-up system that not only monitors satisfaction, but also measures benefit.

[1] Companies with sales of $15 million/year or less. Companies with sales greater than $15 million will pay for the service.

PROPOSED PROGRAM

Technical Extension should be designed as a single national service that can be customized by each participating state, allowing emphasis on their own in-state research, university faculty, and other state resources (see *Service Flow Chart*, page 17). The service should, at a minimum, include the following:

1. Direct access in a convenient, standardized way to technical experts who can provide needed assistance. This expert access service must have no gaps and must cover all areas of technology, both theoretical and practical.

2. Ready access to needed technical information in print. Access should be provided by an interactive remote literature searching process.

3. National databases that describe and catalog, in a standardized way, all intellectual property across the country. This should include all intellectual property from universities, national laboratories, and federal agencies. Companies, technology brokers and individuals should also be encouraged to participate.

4. Access to all the many other federal and state services that are useful to industry.

5. Access to vendor, marketing, demographic, and other information that is complementary to technology or useful to industry.

All state technology extension programs should include services provided by the federal government. Technical resources and help available from the federal government through its sponsorship of research activities and agencies (NIH, DOE, ODD, NASA, DOC, NSF, etc.) far exceed the assistance available in even the most progressive states. Some states, in fact, lack resources sufficient to support even a minimal program.

Technical extension or outreach represents a change in culture for most small, medium, and many large companies. If it is to become an accepted, natural, routine process within such cultures, active hands-on training and encouragement of prospective users is required. The service must be: 1) grass roots, 2) marketed, 3) complete, 4) psychologically acceptable, 5) designed to include a follow-up loop allowing verification of satisfaction, and 6) above all, convenient.

The service must be complete. If the user does not almost always get the information needed, the resource will be used less and less. For example, university professors can respond to only about 25% of the technical questions asked by companies, since most inquiries deal with hands-on, practical issues often far removed from the theoretical. For

this reason it is essential to recruit experts from national laboratories, consulting groups, and industry (retirees) who have broad practical experience.

While many states (approximately 20) have developed technology transfer programs built around common objectives, the proposed system differs significantly from any other program in the country. It is totally integrated, and the only program that taps expertise on a national scale. The design of the proposed program is based on years of successful experience with both the development and the delivery of such a service. This experience essentially removes the risk that would normally be associated with embarking on such an ambitious effort.

Federal Participation

The federal government has developed technology, as well as other services and programs, which could be very helpful to companies and individuals. Oftentimes, however, these resources go unused, either because their availability is unknown or not understood, or simply because access is difficult. One of the unfortunate aspects of this circumstance is that these barriers are most deterring to the very types of businesses which could derive the greatest benefit from such resources: start-ups, small companies and entrepreneurs-particularly those in rural areas. At the same time, it is generally recognized that successful start-ups and small companies move faster, exhibit more innovation and create more new jobs than their larger counterparts.

With this in mind, it is proposed that all federal technology and services be put into appropriate databases and made accessible to all American companies and individuals who have need. Specifically, it is proposed that:

1.* All technologies (patents or specific know-how) available for license from the federal government be put into a database and made available to system users. This online reference will include a short description of each technology, potential applications, industries where it might be applied, the expected economic benefits, and whether it is subject to continued development. A statement on the requirements for commercialization will also be provided.

2.* Appropriate federally-funded, active research projects be put into a database and made available to system users. This reference will provide the name of the researcher, the level of funding, project status, short and long-term objectives, potential economic impact, and anticipated requirements for commercialization. Because this database would be very large and costly, a database listing the major areas of technical focus at each lab or agency might be considered as an alternative.

3.* All federal services be put into an easy-to-use, comprehensive database and made available to system users. The information provided on each service will include a description of its scope, the department from which it originates, and a phone number. Also included will be the purpose of the service, who qualifies as a recipient, the funding source and whether the service is permanent or temporary.

* Another possible approach in this area would be to direct that some of the databases be put together by individual departments or agencies, rather than melded into a single, comprehensive online reference. In some cases, its likely that the agencies themselves will derive benefit from the existence of the databases.

4. The federal government make available a certain number of federally-employed technical experts. (Note: a reasonable number of experts for the purpose of this proposal is approximately 1000). Each will be put into the National Technical Expert Database using the biographical format attached (see *Appendix* page 21). This format has not only proven most useful to industry, but is also compatible with Teltech's National Expert Database. The following criteria will be used for selection of federally-employed technical experts to be included in the system:

   a. The candidate must want to be part of the program.

   b. The candidate must have good communication skills.

   c. The candidate must be an expert in his/her field. (A system has been developed to determine relative expertise.)

   If each federal expert is contacted two times per month, the total time devoted to this program by the 1000 experts per year would amount to 6 man-years. Each of the 24,000 contacts would represent an opportunity to strengthen the nation's technology transfer effort. Experience indicates that approximately 15% of all network interactions would lead to additional consulting work for the contacted specialist.

   It is highly recommended that experts in the system be paid a reasonable fee. Only through the use of such a compensatory system can one manage the behavior of the experts in the network. In short, some rules are necessary to optimize the service.

   Federal experts must be allowed to participate in the program on the same basis as any other expert in the system. This is a service, and all efforts should be made to accommodate the user. If any existing federal regulations are found to inhibit the process, consideration should be given to modifying those regulations.

State Participation

All states have developed technologies and programs which have the potential to help both companies and individuals. As in the case of federal programs, these resources are often unknown or difficult to access. On this basis it is proposed that:

1. All in-state technologies (patents or specific know-how) available for license from in-state institutions be put into a database and made available to system users. This online reference will include a short description of each technology, potential applications, industries where it might be applied, the expected economic benefits, and whether it is subject to continued development. A statement on the requirements for commercialization will also be provided.

2. Appropriate active research projects taking place in the subscribing state be put into a database and made available to in-state system users. This reference will provide the name of the researcher, the level of funding, project status, short and long-term objectives, potential economic impact, and anticipated requirements for commercialization.

3. A simple, easy-to-use, comprehensive database of all state services be made available to system users. The information provided on each service will include a description of its scope, the department from which it originates, the administrator, and a phone number. Also included will be the purpose of the service, who qualifies as a recipient, the funding source, and whether the service is permanent or temporary.

4. Participating states be required to create an in-state expert database. This resource, which will include university faculty members, will be built using the same biographical format and selection criteria applied to the qualification of experts for the federal network. Experts from within the state will be accessed preferrentially to specialists from outside its boundaries.

5. State companies receiving the service be put into a database where their main products and markets will be identified, along with any other information that might be helpful to another in-state company. This information exchange is viewed as a strategy for promoting inter-company cooperation and patronage. This database could also be shared with other states at the discretion of the participating state.

NOTE: The licensable technology and research databases (federal and state) will be keyed into the basic technology inventory database ("Technology Tree"). Consequently any person looking for an expert or wanting to do a literature search in a given area will automatically be advised that technology in that area is available for license or that there is ongoing research in that field taking place at a state institution or at some federal facility.

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Teltech Capabilities Necessary To A Complete Service

Teltech's standard services will supplement and complement the federal and state services outlined above. Experience indicates that the overlay of these services will ensure that each technology extension system user receives the information/assistance he or she needs more than 95% of the time.

Literature Searching Service

The proposed literature searching service is a special information gathering and transmission capability designed to give users ready, convenient access to print materials specifically relevant to topics of interest. It will deliver the required printed material from throughout the world to small and/or rural companies with the same proficiency that at the present time is realized only by large, urban companies with highly developed and costly literature access capability.

The process will begin with a telephone call to a literature searching specialist. This experienced professional will then act as personal guides through the search procedure.

A search may be conducted in either of two ways:

1. Batch Remote

   In this type of search, the user and the search specialist will confer by telephone until a clear, specific understanding of the information needed is reached. The search specialist then independently searches all relevant databases and coordinates delivery of the selected documents to the client.

2. Interactive Remote

   This is by far the most proficient way to search in most instances. The search will once again begin with dialogue between the user and the searcher aimed at clarifying the information requirement. Unlike the batch remote procedure, however, the client then takes an active role in the search, observing the searcher's manipulation of database content on his/her own computer screen and commenting via telephone (see *Appendix*, page 22). The principal advantage of this interactive process, which is favored by a majority of Teltech subscribers, is that it maximizes the opportunity to pinpoint the documents that are truly relevant to their information need. Once again, the search exercise will culminate with the search specialist coordinating delivery of requested documents directly to the client's office.

The proposed search program will tap a full array of leading databases, including Mead Data Central, DIALOG, BRS, ORBIT, STN, Dow Jones, NewsNet, and a host of others. More than 800 separate databases (see *Appendix*, pages 23 and 24) will be accessible through this service, yielding such information as:

1. Demographics of all kinds--useful to marketing groups.

2. Patent listings and descriptions, both international and domestic, including those from China and Russia.

3. Market studies, trends, predictions.

4. Competitor product announcements.

5. Vendor names and locations

6. Codes, regulations and specifications

7. Chemical abstracts and virtually all published technical information, including many foreign technical papers.

These are just a few of the almost infinite number of areas and topics that can be searched.

Continuing Education

This service will offer a complete curriculum of acclaimed professional development courses in engineering, science, manufacturing and management to help users develop and continue their education and training. Over 500 courses from more than 35 universities, societies and companies will be included. And new courses will be continuously added.

Expert Access

The centerpiece of the National Technical Extension Service will be the personal interaction between users and appropriate national and state experts that can help in making better decisions and solving problems. Experience affirms that consultation with experts who can provide reliable and timely insight and advice is the best critical path technical management tool for any company anywhere. Fortunately, because of advances in computers and telecommunications, this most valuable of services can be provided to rural companies as easily as it is provided to urban companies.

Teltech presently offers a network of 6,000 technical specialists (experts), peer recommended, qualified and under contract that could back up the federal and in-state expert service and provide help in virtually all technologies useful to industry, both from a theoretical and practical point-of-view. This present-day, proven network is comprised of specialists recruited from universities across the country, national laboratories, consulting groups, and industry (retirees).

How The Service Will Work

When an individual wants to access any of the services provided, he/she will turn on a PC equipped with the needed software. From that point on, the process is to be menu driven. If, at any time, the user experiences difficulty in accessing the system, he/she will be able to refer to a "help section" online, or call the service Help Staff.

If contact with an expert is desired, the appropriate specialist will be identifiable merely by typing in the word or words that name the area of technical interest. Finally, after reviewing several appropriate expert biographies and making a selection, the user will call the chosen expert, identify himself/herself as a program participant and then proceed with the inquiry. The system will be designed to select in-state experts first, federal experts second, and finally, other Teltech experts. The literature searching procedure has already been discussed on page 6.

Other services will be accessible to the user by following simple online instructions.

It will be possible to conveniently print out anything appearing online at the user location. Also, the system will provide for follow-up on every interaction to confirm satisfaction or to determine the need for additional help.

Since a service resembling the one proposed herein has been in successful operation for several years, efficacy of the entire process can be easily demonstrated.

Guidance And Training

The process at the center of this proposed system will require, to some degree, a change in the culture of American industry. Beyond personal networks developed by individual technical professionals, companies in this country have generally not availed themselves of the potential power of day-to-day technical outreaching. Further, most cooperative arrangements between companies and various laboratories or universities are project oriented, having been consummated at the management level, rarely penetrating to the technologists who are actually dealing with the day-to-day critical path technical issues that determine the competitiveness of these companies. In addition, most start-ups and small companies do not have the needed access to technical and other literature.

It is a fact that the average technologist spends approximately 25% of his/her time looking for information in unfamiliar technical areas, and finds what he/she is looking for only 50% of the time. One wonders how much competitiveness turns on the 50% that was not found. The proposed National Technical Extension Service will save time and increase success at finding needed information to 98% (see *Appendix*, page 25).

The type and distribution of inquiries expected through a National Technical Extension Service are shown in the *Appendix* pages 26 and 27.

In light of the above, it is important that each user be guided and trained in application of the service. This proposal includes the deployment of service representatives who will work with each user company (similar to the Agricultural Extension Service) on a regular basis to ensure realization of maximum benefit. The goal is to help each user make the process of technical outreach a routine part of his/her professional life. Users will learn through this training that, apart from the benefits that the service's availability will accrue to their respective employers, they, too, will be enriched owing to their ability to stay professionally current.

Public Points Of Service

The objective is to provide the service directly to qualifying companies, while also making it available to entrepreneurs who might derive benefit in each subscribing state . It is therefore proposed that each state have an appropriate number of public access points. Typical points of public access will be libraries, Innovation Centers, vo-techs, state universities, and extension offices.

Qualifying Companies

All start-up and small companies with gross annual sales of $15,000,000 or less will qualify to receive the proposed service without charge (see *Providing the Service*, page 11).

COST TO DEVELOP AND DELIVER THE SERVICE (TEN YEAR PHASED PROGRAM)

Before the proposed Technical Extension Service can be put in place, databases will need to be completed both by the federal government and by subscribing states.

Federal Government

1. Interviewing and qualifying 1,000 specialists for the federal expert system will cost approximately $200 per expert, or $200,000 the first year. Maintenance of this network after the first year will cost an estimated $50,000 annually.

2. Putting together a database of licensable technologies will cost approximately $200 per technology listing. Based on an estimated "inventory" of 3,000 licensable technologies, first year development costs would total $600,000. Maintenance of this database would cost approximately $120,000 per year thereafter.

3. Putting together a database listing the main scientific or engineering interest of each federally funded research institution will cost $200 per item. Assuming an average of 20 items per institution and 200 institutions, the total cost would be $800,000. Maintenance per year would be $160,000[2].

4. Building a database of federal services will cost $200 per item. Estimating 500 separate services from the many departments and agencies, the cost would be $120,000. Maintenance costs thereafter would be $25,000 annually.

5. The estimated cost of the computer, memory, and software is $1,000,000.

6. A system for classifying technologies--called the "Technology Tree"--and the thousands of access words needed to organize and manage this aspect of the service has already been proven by Teltech. Much of the software needed to build the federal program is therefore already available for license. This "Technology Tree" is dynamic, and must be continually enlarged and updated ($500,000 per year).

All cost estimates assume cooperation from each department or agency through submission of needed information on appropriate forms for editing and inclusion in the database. Estimates are based on limited inquiry and would need to be verified prior to final program budgeting.

CHART 1 **Cost Summary- Database Development And Maintenance**

Total Cost, First Year Per Above - BUDGET = $5,000,000	$3,220,000
Total Cost Per Year Thereafter Regardless Of Program Size Per Above - BUDGET = $2,000,000	$855,000

[2] Estimated cost to place all appropriate federally-funded research into a database is $15 - 20,000,000. Maintenance would require $4 - 6,000,000 per year.

Subscribing States

Each state is different, but one can safely estimate that each state will need to invest between $100,000 - $600,000 in establishing the necessary in-state databases, and will spend an additional $20,000 - $120,000 per year in maintaining such databases.

Providing The Service

Many cost models have been considered. The one that is recommended gives all qualifiers (users) access to the program without charge the first year. Specifically, the program will operate as follows:

1. The federal government will fund preparation, delivery and maintenance of databases and services on the national level, making them available for inclusion in all state programs.

2. State governments will fund preparation and maintenance of state-level databases and services as part of their in-state technical extension programs.

3. The cost of delivering such services to users in each subscribing state will be shared with the federal government on a 50-50 basis.

Who Qualifies

All individuals and companies with gross annual sales of less than $15,000,000 qualify to receive the service as follows:

1. All individual users and small companies representing gross annual sales of less than $2 million will receive the service at no charge.

2. Companies with gross annual sales of between $2 - 5 million will receive the service 100% free the first year, 75% free the second year and 50% free thereafter (see *Chart 2* below).

CHART 2 Payment Schedule For Companies With Gross Annual Sales Of $2-5M

Year	Fed. Gov. Pays	States Pay	User Pays
First	50%	50%	0%
Second	37.5%	37.5%	25%
Third	25%	25%	50%

Note: In succeeding years, payment will remain at 25%-25%-50% until annual sales exceed $5 million.

3. For companies with gross annual sales of $5 - 15 million, the service will be provided 100% free the first year, 75% free the second year 50% free the third year and 25% free the fourth year, with the company paying 100% of the cost thereafter (see *Chart 3* below).

CHART 3 **Payment Schedule For Companies With Gross Annual Sales Of $5-15M**

Year	Fed. Gov. Pays	States Pay	User Pays
First	50%	50%	0%
Second	37.5%	37.5%	25%
Third	25%	25%	50%
Fourth	12.5%	12.5%	75%
Fifth	0%	0%	100%

Once a company generates over $15 million in annual sales revenue, it will no longer qualify for federal or state support funding under the Federal Technical Extension Service program.

It is anticipated that other payment schemes will be discussed and evaluated as part of the program development/approval procedure.

Assumptions

1. Five states will be brought into the service each year over a ten year period. (Program could obviously be accelerated in ensuing years based on results).

2. Service will be provided to all companies with gross annual sales of less than $15,000,000 per the schedule above. In addition, the service will be provided at public locations (extension offices, libraries, vo-techs, state universities, user locations, and Innovation Centers in subscribing states).

3. The service will operate via reference to Teltech's existing "Technology Tree," containing over 14,000 access words and allowing direct access by key word, or by browsing. The "tree" will be expanded as required.

4. All standard Teltech services will be provided.

5. All databases will be updated on a continuing basis. Annual or even semi-annual updating is judged insufficient. This study assumes database turnover of 20% per year.

6. Company turnover will be 20% per year, comprised of both those companies coming into the program and those leaving.

7. One program manager will be required for every 50-100 companies in the program.

8. There are presently 40,000 companies in the United States that could qualify for the service. This estimate breaks down as follows:

   25,000 companies with sales less than $2,000,000
   7,500 companies with sales between $2-5,000,000
   7,500 companies with sales between $5-15,000,000

   The above numbers were established by factoring data from several sources. As such, confidence in the accuracy of these estimates is qualified. It follows that many of the numbers upon which this proposal is based will at some point need to be verified.

9. Approximately 4,000 companies in five states will initially qualify

10. All online costs (database access) will be paid by the service provider. Also, experts will be paid $75.00 per interaction. These costs are included in the total estimated costs given in the next section.

11. Besides provision of direct service to qualifying companies, approximately 100 public access points will be established in each state.

Estimated Cost To Provide Service

Estimated cost of delivering the service to qualifying companies, groups, and individuals throughout the country:

CHART 4* Cost To Deliver The Service

Year	Fed. Gov. Pays	States Pay	States In Prog.	Total Cost
1st	$13M	$13M	5	$26M
2nd	23M	23M	10	46M
3rd	33M	33M	15	66M
4th	42M	42M	20	84M
5th	51M	51M	25	102M
6th	60M	60M	30	120M
7th	69M	69M	35	138M
8th	78M	78M	40	156M
9th	87M	87M	45	174M
10th	96M	96M	50	192M
11th+	90M	90M	50	180M

Cost per state declines over time because some companies are sharing in the cost and some are phased out of the program (see *Charts 2 and 3*, pages 11 and 12).

The above cost estimates are judged reasonable and accurate based on available information. Service usage rates and the number of companies receiving the service will be the main variables in determining actual costs. However, limits could be placed on free usages as a method of stabilizing costs.

Total annual cost of implementing the system, including database development & maintenance is estimated as follows:

CHART 5* Total Cost Per Year, Including Database Development & Maintenance

Year	Fed. Gov. Pays	States Pay	States In Prog.	Total Costs
1st	$18M	$16M	5	$34M
2nd	25M	26M	10	51M
3rd	35M	37M	15	72M
4th	44M	46M	20	90M
5th	53M	56M	25	109M
6th	62M	65M	30	127M
7th	71M	74M	35	145M
8th	80M	83M	40	163M
9th	89M	92M	45	181M
10th	98M	101M	50	199M
11th+	90M	100M	50	190M

* Chart 4 and Chart 5 assume that all states will participate, while in fact some states may decline.

CONCLUDING COMMENTS

1. The validity of a program is finally determined by measurement of the benefit it produces. A protocol for determination of benefit should be agreed upon by the federal government and subscribing states. Benefits should be reported on a quarterly basis.

2. The federal government spends approximately $60 billion on research, while states also invest substantial resources in additional research. This proposal suggests that only one-third of one percent of the federal research budget need be spent to significantly strengthen the benefit of this research to American industry.

3. The proposed program will promote increased national appreciation of federal and state services.

4. It is important to point out that the proposed program represents a grass roots effort. The person needing help is put in direct contact with someone who can provide the assistance he/she needs. There will be no intermediaries. And in order to avoid encumbering this direct relationship, there will be very few rules and regulations.

5. In addition to the benefits derived by American industry, both the federal government and subscribing states will also derive benefit as users of these databases. Some states that have not been particularly successful at industrial outreach claim that similar databases are worth maintaining for internal governmental use only.

6. The proposed service is unique. There is no comparable program in the country that is as complete or more tightly managed from a service and follow-up point-of-view.

7. Once the system is well established, other potentially beneficial services can be added with ease.

8. The type of service proposed herein has been operating successfully in the private sector for a number of years. Therefore, adoption of this program represents minimal risk. Further, the system is quite predictable with respect to benefits. Benefits over cost can be expected at an approximate ratio of 20 to 1. Studies done by the Department of Energy and Department of Defense confirm this expectation[3].

9. The essence of the proposed program is the sharing of the best technology and the best technical minds in the country--the ultimate in technology transfer.

[3] AGARD Study, DOE and DOD (1985).

10. The State of Minnesota has already committed to adopting the state-level program described in this proposal. Also, a pilot model of the proposed program has been implemented in Anoka County, Minnesota.

11. The proposed service represents the first time ever that rural companies and entrepreneurs will have access to needed technologies and knowledge equal to that enjoyed by their urban counterparts.

12. There is a consensus that trying to transfer technology by "pushing it out" does not work very well. In contrast, the proposed program utilizes a "pull" process that has consistantly proven to work well.

13. Over the last 10 years, the U.S. has increased its productivity levels less than any of its major competitors[4]. At the same time, the U.S. is headed into a period where there will be a shortage of engineers.

14. The average industrial payback on research is 2 to 1. Sharing technology has a payback of 20 to 1[5].

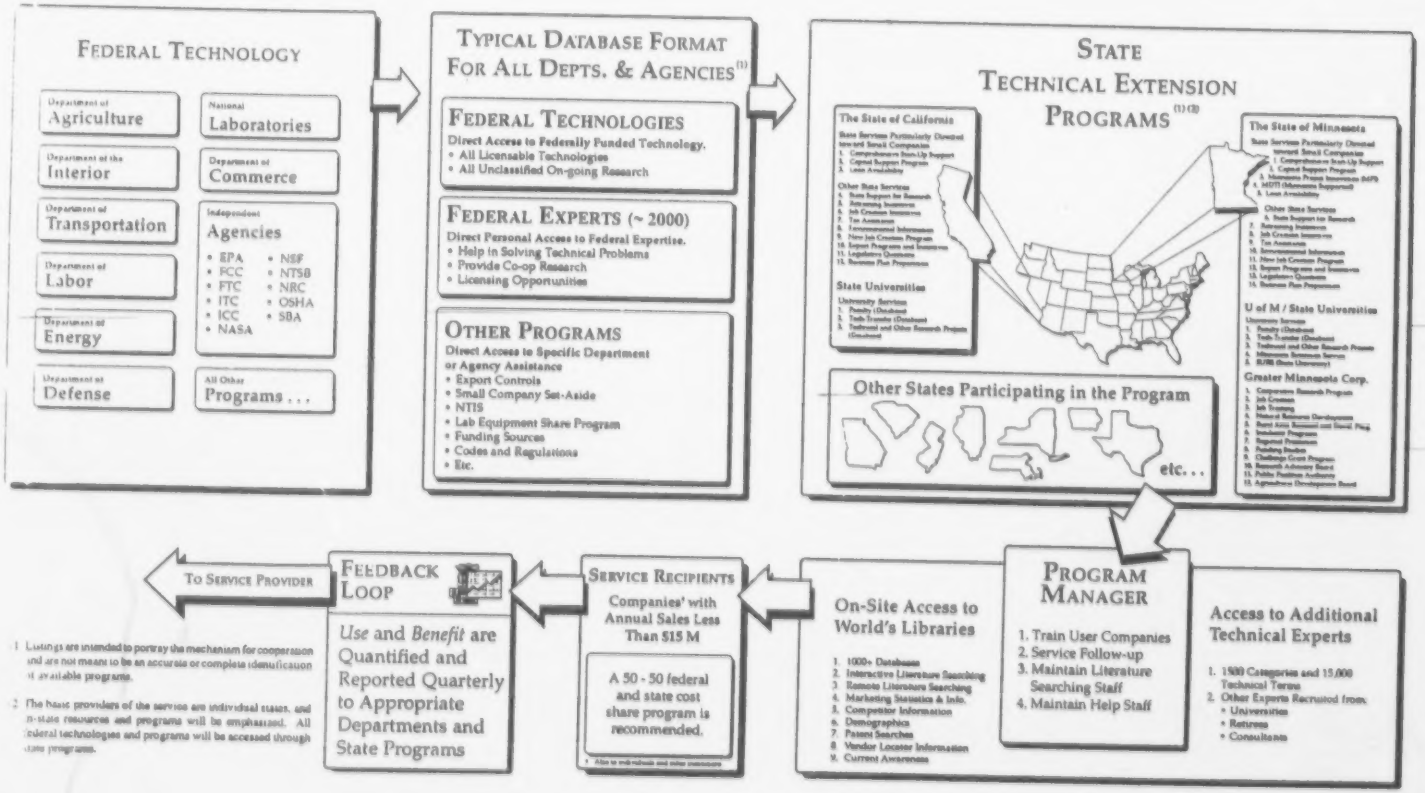
[4] *R&D Update*, January 1989

[5] *Managing the Flow of Technology*, Thomas J. Allen, MIT

NATIONAL TECHNICAL EXTENSION

A Service Provided by the Federal Government in Cooperation with State Governments

Telatech Conceptual Model
Submitted 5-11-89


FEDERAL TECHNOLOGY
Department of Agriculture
Department of the Interior
Department of Transportation
Department of Labor
Department of Energy
Department of Defense
National Laboratories
Department of Commerce
Independent Agencies
• EPA • NSF
• FCC • NTSB
• FTC • NRC
• ITC • OSHA
• ICC • SBA
• NASA
All Other Programs . . .
TYPICAL DATABASE FORMAT FOR ALL DEPTS. & AGENCIES (1)
FEDERAL TECHNOLOGIES
Direct Access to Federally Funded Technology.
• All Licensable Technologies
• All Unclassified On-going Research
FEDERAL EXPERTS (~ 2000)
Direct Personal Access to Federal Expertise.
• Help in Solving Technical Problems
• Provide Co-op Research
• Licensing Opportunities
OTHER PROGRAMS
Direct Access to Specific Department or Agency Assistance
• Export Controls
• Small Company Set-Aside
• NTIS
• Lab Equipment Share Program
• Funding Sources
• Codes and Regulations
• Etc.
STATE TECHNICAL EXTENSION PROGRAMS (1) (2)
The State of California
The State of Minnesota
U of M / State Universities
Greater Minneapolis Corp.
Other States Participating in the Program
etc. . .
PROGRAM MANAGER
1. Train User Companies
2. Service Follow-up
3. Maintain Literature Searching Staff
4. Maintain Help Staff
On-Site Access to World's Libraries
1. 1000+ Databases
2. Interactive Literature Searching
3. Remote Literature Searching
4. Marketing Statistics & Info.
5. Competitor Information
6. Demographics
7. Patent Searches
8. Vendor Locator Information
9. Current Awareness
Access to Additional Technical Experts
1. 1500 Categories and 15,000 Technical Terms
2. Other Experts Recruited from
• Universities
• Retirees
• Consultants
SERVICE RECIPIENTS
Companies' with Annual Sales Less Than $15 M
A 50 - 50 federal and state cost share program is recommended.
FEEDBACK LOOP
Use and Benefit are Quantified and Reported Quarterly to Appropriate Departments and State Programs
TO SERVICE PROVIDER

1. Listings are intended to portray the mechanism for cooperation and are not meant to be an accurate or complete identification of available programs.

2. The basic providers of the service are individual states, and in-state resources and programs will be emphasized. All federal technologies and programs will be accessed through state programs.

APPENDIX

Actual Examples Of Service Application ____ 19

Sample Biographical Data ____ 21

Interactive Literature Searching ____ 22

Databases Interactively Accessible Through The Program ____ 23

Information Gathering With And Without A National Technical Extension Service ____ 25

Typical Service Inquiries ____ 26

Technical Inquiries Distribution ____ 27

ACTUAL EXAMPLES OF SERVICE APPLICATION

COMPANY	Manufacturer of hand tools and automotive after market test equipment.
SITUATION	Client had run tests comparing their automotive dwell control measurement device readings to those of competitive device. Results indicated significant differences. Client elected to initiate study to determine which instrument was yielding the correct measurements.
SOLUTION	Help Staff located expert at public institution aligned with auto industry. Specialist consulted with a small group of his own colleagues and devised method for concluding which device was taking the correct reading.
BENEFIT	Client finished comparative study project two weeks ahead of scheduled completion date. Client contact also documented expert's recommendations for his supervisors, becoming instant "hero" and insuring that knowledge brought into company by the expert would remain available to others within the firm.

COMPANY	Manufacturer of custom machinery.
SITUATION	Client and his customer were in disagreement over computer language to be used by custom-developed automated equipment.
SOLUTION	Client used their PC and TELTECH software to identify expert. Telephone contact resulted in expert advising that client's language recommendation was far better suited to the application. Affirmed this judgement by providing written and oral justification to client's customer. Credibility of expert's counsel was enhanced by the fact that customer was aware of his highly favorable reputation.
BENEFIT	Client realized $100,000 cost savings by installing expert-recommended language instead of that initially favored by customer.

COMPANY	Manufacturer of commercial and industrial air filters.
SITUATION	Client had decided to purchase an electronic publishing system which would allow elimination of significant amounts of manual task work. Was seeking equipment and software recommendations.
SOLUTION	Help Staff directed client to in-house expert who quickly developed understanding of need, conducted on-site demonstration and provided print material substantiation for system recommendation. Client accepted expert's proposal and followed through with purchase of system.
BENEFIT	Client installation of recommended hardware/software package has yielded approximate annual savings of $12,000 to $18,000 through reduction of manual task work.

ACTUAL EXAMPLES OF SERVICE APPLICATION (cont.)

COMPANY	Developer and producer of ultra-high molecular weight polyethylene materials.
SITUATION	Client engaged in production of polymer for use in artificial knee caps. Compliance with standards for material purity was being checked by employee with microscope who inspected each piece and literally counted the number of impurities present. Client approached Help Staff citing need for faster, less expensive method of quality control.
SOLUTION	Help Staff provided client with the names of several experts currently in the network, recommending which individual they might approach first. Initial call produced "right" specialist who, after consulting with a colleague, brought forth a proposal that the client replace the existing inspection methodology with an electronic monitoring system used by biologists. Recommendation was successfully implemented.
BENEFIT	Estimated savings of $25,000 annually owing to elimination of human inspector function.

COMPANY	Biomedical equipment supplies
SITUATION	Client company had been approached by private inventor offering exclusive marketing rights to a jet injector for delivering insulin dosages. In spite of inclination to immediately proceed with the project, client elected to evaluate patent strength, market potential and competitive situation before making "go, no-go" decision.
SOLUTION	Help Staff located former employee of company competing in the jet injector market area. Specialist travelled to the client site and, based upon his product and market understanding, concluded that the new injector would not only be hard to differentiate from existing product alternatives, but that it lacked technical parity with competitive offerings. Client responded by immediately discontinuing negotiations with product inventor.
BENEFIT	Savings conceivably in multi-million dollar range, owing to client decision to abort ill-fated marketing investment.

COMPANY	Manufacturer of microelectronic circuits and components.
SITUATION	Heat chambers located in each of 40 microelectronics test units were breaking down at a rate of one per day. Problem evident in failure of equipment to adhere to strict heating and cooling cycle timing patterns required by regulatory agency test standards. Resulted in critical down time of equipment; inability to efficiently monitor component performance capabilities. Client was unable to solve problem on own, and a survey of available consultants revealed that use of their services would be expensive.
SOLUTION	Help Staff identified expert qualified to address the client problem. After providing initial consultation via telephone, specialist went on-site and quickly determined that malfunction stemmed from deficiencies in vendor-supplied software used to drive test equipment micro-computer. Expert was later called in to identify and resolve problems associated with internally-developed client software materials.
BENEFIT	Referring to Teltech specialist as "Houdini" and "wizard", client acknowledges that costly problem was fully resolved via telephone contact and on-site consultation. Our expert's $3,000/week consulting fee compared with $5,000/day average charge from other consultants in the field.

SAMPLE BIOGRAPHICAL DATA

DR. RICHARD A. ORIANI — ID# ORIA72 — (612)625-5862

EDUCATION:			
	1948	PhD	Physical Chemistry, Princeton University
	1948	MA	Physical Chemistry, Princeton University
	1946	MS	Chemistry, Stevens Institute of Technology
	1946	BS	Chemical Engineering, Brooklyn College and the College of the city of New York

EMPLOYMENT:		
	1980...	PROFESSOR AND DIRECTOR EMERITUS CORROSION RESEARCH CENTER UNIVERSITY OF MINNESOTA
	1959-80	Senior Research Consultant U.S. Steel Research Laboratory
	1948-59	Researcher, GE

Dr. Oriani's (pronounced Or-ee-an-ee) expertise combined with 30+ years of industrial experience made him the ideal selection for the first Director of the CORROSION Research Center at the University of Minnesota. He is one of the nation's best experts in the areas of HYDROGEN EMBRITTLEMENT OF METALS, SOLUTION CORROSION, and physical chemistry of metals. Dr. Oriani particularly enjoys seeking out scientific approaches to industrial problems. He has solved problems in CONTINUOUS CASTING, NITRIDING, and TIRE CORDS.

Dr. Oriani's knowledge includes corrosion of all types of FERROUS METALS (CARBON STEEL, STAINLESS STEEL, and other ALLOYS) as well as many NONFERROUS METALS including NICKEL, COPPER, COPPER ALLOYS, GOLD, and PLATINUM.

At GE, Dr. Oriani did research in ALLOY THERMODYNAMICS, NMR, and DIAMOND SYNTHESIS. His research at U.S. Steel dealt with ELECTROMIGRATION, NUCLEATION, ELECTROCHEMISTRY, DIFFUSION, THERMODYNAMICS of ELASTICALLY STRESSED BODIES, KINETICS OF REACTIONS, COARSENING IN SOLID SYSTEMS, PHASE TRANSITIONS, OXIDATION, NITROGENATION, and IMPACT PHENOMENA. He is now heavily involved in the field of ELECTRICALLY CONDUCTING POLYMERS.

AFFILIATIONS AND ACCOMPLISHMENTS: Dr. Oriani has edited two books: PHYSICAL CHEMISTRY IN METALLURGY, PROCEEDINGS OF THE DARKEN CONFERENCE and HYDROGEN DEGRADATION OF FERROUS ALLOYS. He is a fellow of the American Society for Metals, the American Institute of Chemists and the New York Academy of Sciences, and he has received the W. R. Whitney Award (1987) from NACE.

CALLING INFORMATION: When Dr. Oriani is unavailable at the above number, a secretary or associate will take a message. Other number: 612-822-2774 home.

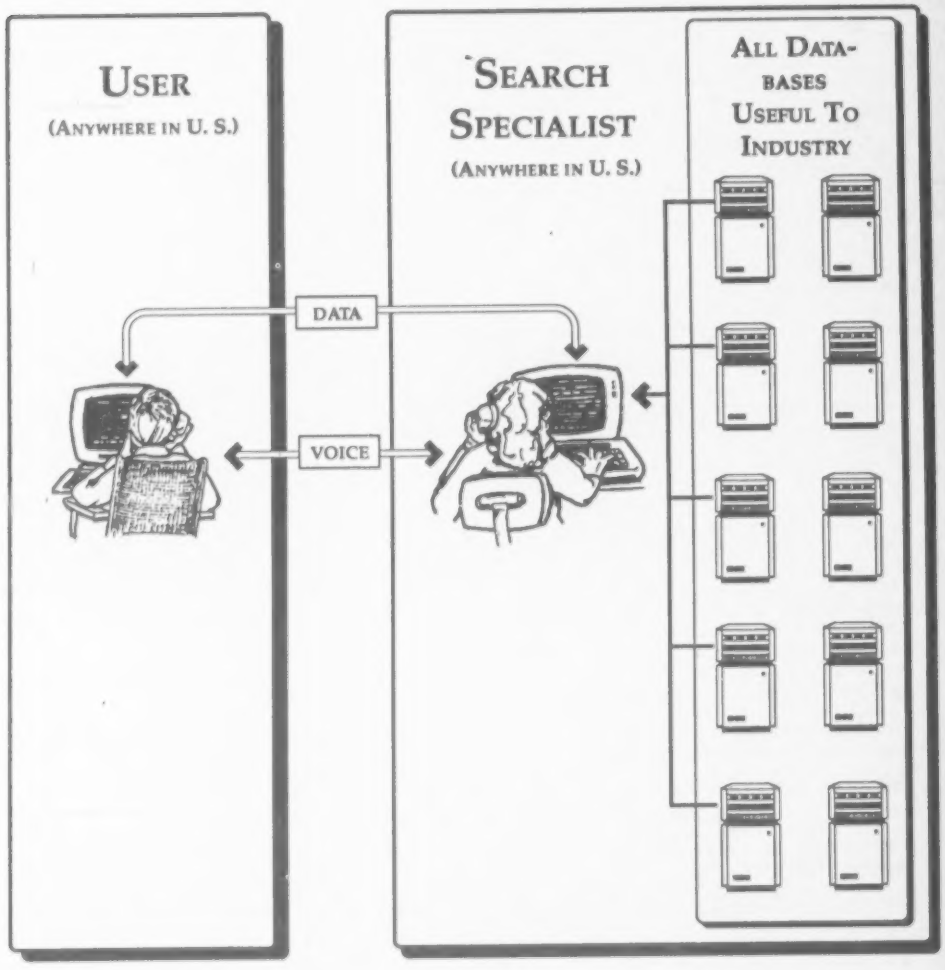
ANCILLARY SERVICE AVAILABILITY: Dr. Oriani is available for on-site consultation and will handle billing directly. He prefers not to testify in a lawsuit.

LANGUAGES: Dr. Oriani is able to speak, read, and write Spanish, and can read and write French.

HOBBIES: Dr. Oriani is an amateur musician, and he enjoys hiking, carpentry, and civic activities.

* WHAT TO DO NEXT (FOR CALLING EXPERTS): CALL THE EXPERT AT THE ABOVE NUMBER. *
* IDENTIFY YOURSELF AS A TELTECH USER WITH YOUR USER ID NUMBER, (YOU NEED NOT *
* IDENTIFY YOUR COMPANY NAME), AND DISCUSS YOUR ISSUE. THAT'S IT! *

INTERACTIVE LITERATURE SEARCHING



PARTIAL LISTING OF THE DATABASES INTERACTIVELY ACCESSIBLE THROUGH THE PROGRAM*

AGRICULTURE AND NUTRITION

AGRICOLA
AGRIS INTERNATIONAL
BIOSIS
CAB ABSTRACTS
CRIS/USDA (CURRENT RESEARCH IN AGRICULTURE)
FOOD SCIENCE AND TECHNOLOGY ABSTRACTS
FOODS ADLIBRA
MEDLINE
TROPAG (TROPICAL AGRICULTURE)

BIBLIOGRAPHY—BOOKS, MONOGRAPHS AND PERIODICALS

BOOK REVIEW INDEX
BOOKSINFO
BOOKS IN PRINT
CALIFORNIA UNION LIST OF PERIODICALS
GPO MONTHLY CATALOG
GPO PUBLICATIONS REFERENCE FILE
LC MARC (LIBRARY OF CONGRESS HOLDINGS)
REMARC (LIBRARY OF CONGRESS HOLDINGS)
ULRICH'S INTERNATIONAL PERIODICALS DIRECTORY
WILEY CATALOG/ONLINE

CHEMISTRY

CHEMICAL ABSTRACTS
CHEMICAL ENGINEERING ABSTRACTS
CHEMICAL EXPOSURE
CHEMICAL INDUSTRY NOTES
CHEMICAL JOURNALS ONLINE
CHEMICAL REGULATIONS AND GUIDELINES SYSTEM
CHEMLAW
CHEMNAME (CHEMICAL NOMENCLATURE)
CHEMSEARCH (CHEMICAL NOMENCLATURE)
CLAIMS COMPOUND REGISTRY (CHEMICALS CITED IN PATENTS)
FINE CHEMICALS DIRECTORY
HAZARDLINE (TOXIC EFFECTS OF CHEMICALS)
KIRK - OTHMER ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY
MERCK INDEX
OHM/TADS (HAZARDOUS MATERIALS)
PAPERCHEM
REGISTRY (CHEMICAL NOMENCLATURE)
RTECS (REGISTRY OF TOXIC EFFECTS OF CHEMICALS)
SANSS (STRUCTURE AND NOMENCLATURE)
SCISEARCH (SCIENCE CITATION INDEX)
TSCA INVENTORY
ZINC LEAD CADMIUM ABSTRACTS

COMPANY AND FINANCIAL SOURCES

DISCLOSURE II
D & B - DUN'S MARKET IDENTIFIERS
D & B - KEY BRITISH ENTERPRISES
D & B - MILLION DOLLAR DIRECTORY
D & B - PRINCIPAL INTERNATIONAL BUSINESSES
ELECTRONIC YELLOW PAGES
ICC BRITISH COMPANY DIRECTORY
IHS VENDOR INFORMATION
INTERNATIONAL LISTING SERVICE
INVESTEXT (INVESTMENT RESEARCH REPORTS)
PTS ANNUAL REPORTS ABSTRACTS
STANDARD AND POOR'S NEWS
TRINET ESTABLISHMENTS

COMPUTER SCIENCE

BUSINESS SOFTWARE DATABASE
COMPENDEX
COMPUTER DATABASE
INSPEC (IEEE)
MENU (INTERNATIONAL SOFTWARE)
MICROCOMPUTER HARDWARE AND SOFTWARE GUIDE
SUPERTECH

CURRENT AFFAIRS

AP NEWSWIRE
BUSINESS WIRE
CANADIAN BUSINESS AND CURRENT AFFAIRS
CHRISTIAN SCIENCE MONITOR
FINANCIAL TIMES
JAPANESE ECONOMICS NEWSWIRE
MAGAZINE ASAP
MAGAZINE INDEX
MIDDLE EAST: ABSTRACTS AND INDEX
MIDEAST FILE
NATIONAL NEWSPAPER INDEX
NEWSEARCH
NEWSNET
NEXIS
PAIS INTERNATIONAL (SOCIAL SCIENCE TOPICS)
PR NEWSWIRE
REUTERS
STANDARD AND POOR'S NEWS
TRADE AND INDUSTRY ASAP
UPI NEWS
VUTEXT
WASHINGTON POST INDEX
WORLD AFFAIRS REPORTS

DIRECTORIES

AMERICAN MEN AND WOMEN OF SCIENCE
BIOGRAPHY MASTER INDEX
CAREER PLACEMENT REGISTRY/ EXPERIENCED PERSONNEL
CAREER PLACEMENT REGISTRY/STUDENT
ENCYCLOPEDIA OF ASSOCIATIONS
MARQUIS WHO'S WHO
PETERSON'S COLLEGE DATABASE
ULRICH'S INTERNATIONAL PERIODICALS DIRECTORY

EDUCATION

AIM/ARM (VOCATIONAL EDUCATION)
BILINGUAL EDUCATION BIBLIOGRAPHIC ABSTRACTS
EDUCATIONAL TESTING SERVICE TEST COLLECTION
ERIC
EXCEPTIONAL CHILD EDUCATION RESOURCES
ONTARIO EDUCATION RESOURCES INFORMATION DATABASE
RESOURCES IN COMPUTER EDUCATION
RESOURCES IN VOCATIONAL EDUCATION
TEXAS EDUCATION COMPUTER COOPERATIVE
VOCATIONAL EDUCATION CURRICULUM MATERIALS

ENERGY AND ENVIRONMENT

APTIC (AIR POLLUTION)
AQUACULTURE
AQUALINE
BIOSIS
CHEMICAL ABSTRACTS
COLD (COLD REGIONS RESEARCH)
DOE ENERGY
EBIB (ENERGY BIBLIOGRAPHY)
ELECTRIC POWER DATABASE
ENERGYLINE
ENERGYNET
ENVIROLINE
ENVIRONMENTAL BIBLIOGRAPHY
EPRI (ELECTRIC POWER)
FOREST
OCEANIC ABSTRACTS
POLLUTION ABSTRACTS
POWER
WATERLIT
WATERNET

FOUNDATIONS AND GRANTS

FOUNDATION DIRECTORY
FOUNDATION GRANTS INDEX
GRANTS

INDUSTRY SPECIFIC SOURCES

ADTRACK (ADVERTISING)
CHEMICAL INDUSTRY NOTES
COFFEELINE
DMS (DEFENSE MARKET REPORTS)
FOODS ADLIBRA
FOOD SCIENCE AND TECHNOLOGY ABSTRACTS
INSURANCE PERIODICALS INDEX
PAPERCHEM
PHARMACEUTICAL NEWS INDEX
PTS DEFENSE MARKETS AND TECHNOLOGY
PTS MARS (ADVERTISING)

LAW AND GOVERNMENT

ASI (AMERICAN STATISTICS INDEX)
CHEMICAL REGULATIONS AND GUIDELINES SYSTEM
CIS (CONGRESSIONAL INFORMATION SERVICE)
COMMERCE BUSINESS DAILY
CONGRESSIONAL RECORD ABSTRACTS
CRIMINAL JUSTICE PERIODICALS INDEX
FEDERAL INDEX
FEDERAL REGISTER ABSTRACTS
GPO MONTHLY CATALOG
GPO PUBLICATIONS REFERENCE FILE
LABORLAW
LEGAL RESOURCE INDEX
NCJRS (NATIONAL CRIMINAL JUSTICE REFERENCE SERVICE)
NTIS
PATLAW
TSCA INVENTORY

* Approximately 400 listed of the 900 available.

PARTIAL LISTING OF THE DATABASES INTERACTIVELY ACCESSIBLE THROUGH THE PROGRAM (cont.)

MANAGEMENT, MARKETING, AND INDUSTRY SOURCES

ABI INFORM
ACCOUNTANTS
ARTHUR D. LITTLE ONLINE
CANADIAN BUSINESS AND CURRENT AFFAIRS
COMMERCE BUSINESS DAILY
ECONOMIC LITERATURE INDEX
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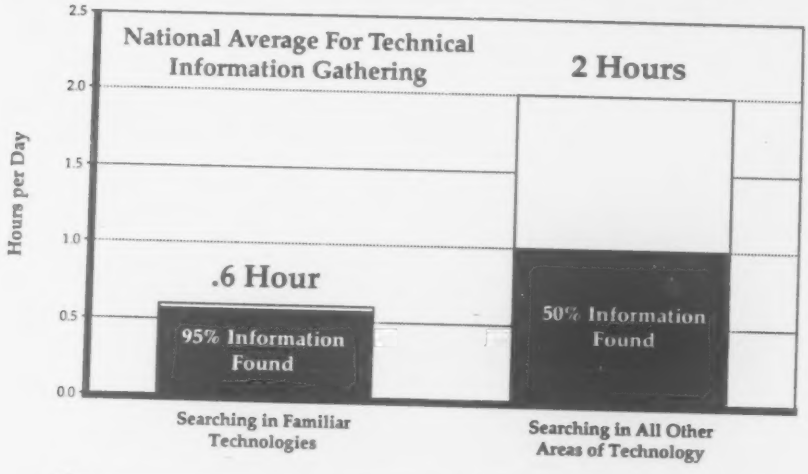
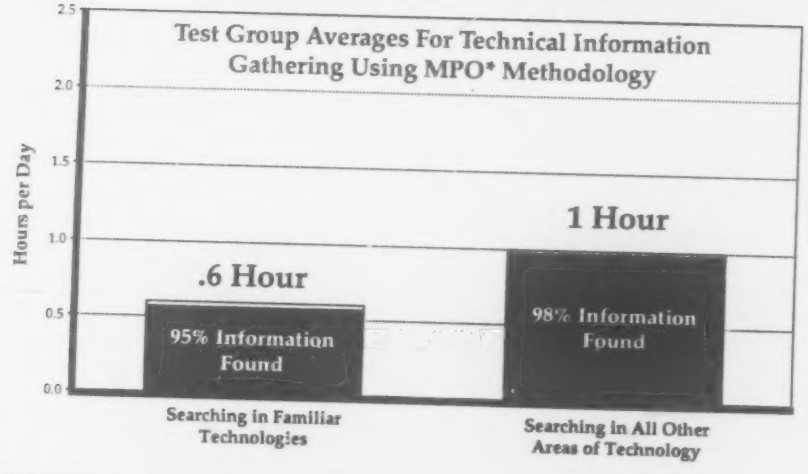
INFORMATION GATHERING WITH AND WITHOUT A NATIONAL TECHNICAL EXTENSION SERVICE





Anticipated user benefits:

- **Average time savings of 12.5% (1 hour / day)**
- **48% increase in success at finding needed information**

* Minnesota Project Outreach - Basis for recommended national program.

TYPICAL SERVICE INQUIRIES

Toxic Control of Cesium Titanate
Statistics on Medical Software Recall
Patents on Tantalum Doping
Design of Spiral Groove Thrust Bearings
Controlling Chassis Corrosion
Uncooled Thermal Imaging
Burn treatment using Mimosa Tenuiflora
Patents on Silicon Nitride
Electrical Discharge Machining of Ceramics
Electrodeposition of Paints
Cerebral Blood Flow Measurement
Determination of Protein in Urine or Spinal Fluid
Acid Pump Manufacturers
Containment of Rotor Fragments
Metal Detection in Food Processing
Patents on Mirror Coating Processes
Design of Aircraft Engine Diffusers
Hydrogen Embrittlement of Stainless Steel
Storage Vessels for Quanidine Hydrochloride
Oxygen Diffusion in Perovskite
Designs of Myoelectric Hands
Ethylene Propylene Curing

TECHNICAL INQUIRIES DISTRIBUTION*

SUBJECT	% OF TOTAL INQUIRIES
Product Design Assistance	20%
Product/Process Failure Analysis	18%
Market/Competitive Information	12%
Materials Selection	11%
Patent Searching	10%
Process Development	9%
Manufacturing Cost Reduction	5%
Quality Control	5%
Vendor Locating	5%
Codes and Regulations	2%
General Backgrounding in Unfamiliar Technology	2%
Other	1%

* Teltech's experience based on a sampling comprised of 15,000 inquiries.

Questions from Senator Wallop and answers by Mr. Shuster

Question: Who do you envision as the head of your proposed "National Technical Extension Service"?

Answer: The proposed service will be headed by the Department of Commerce, working through NIST. NIST will contract the service design and implementation responsibility for the program to a private company with proven expertise in technology transfer and the effective delivery of technical information to American industry.

Question: It seems only logical that you would have to charge all businesses a fee for information from the database at a National Technical Extension Service. What fee structure would you propose for technology transfer assistance to pay for the services provided by the extension service?

Answer: The earlier-submitted National Technical Extension Service proposal contains a detailed explanation of recommended fees to user companies. Summarily, this plan allows small businesses with gross annual sales of less than $2 million to access the service at no charge. The cost of providing the service at this level will be borne jointly by the federal and the appropriate state government. Companies with sales between $2 million and $15 million will use the service under terms of a graduated payment or "sunset" schedule that has them assuming responsibility for increasing portions of the service cost over time, according to their annual sales revenue. After four years in the program, for instance, a company with gross annual sales of $5 to $15 millions will assume 100% payment responsibility for use of the service. All companies with sales greater than $15 million will pay for their use of the service from the time it is introduced.

The importance of governmental funding to help defray service access costs for small companies cannot be overstated. Our experience as a successful provider of technical information to businesses of all sizes clearly points up the tendency of start-up and emerging firms to place the resolution of short term operating concerns ahead of paying for potentially beneficial mid- and long-range resource programs. This governmental investment in our country's small businesses promises to be returned many fold through the creation of additional jobs, the strengthening of our success in global markets and a general brightening of the nation's economic future.

Senator BOSCHWITZ. We are going to have to move to the next witness, Mr. Shuster, and leave the comments for the question and answer period.

We now turn to Mr. Bill Rader, who is director of the Arkansas Center for Technology Transfer at the University of Arkansas. Mr. Rader, we will put the entirety of your statement in the record as well, and we ask that you summarize your statement now.

STATEMENT OF WILLIAM H. RADER, DIRECTOR, ARKANSAS CENTER FOR TECHNOLOGY TRANSFER, UNIVERSITY OF ARKANSAS

Mr. RADER. Thank you very much. I appreciate the opportunity to appear before this committee, Mr. Chairman.

I had some written remarks that I was going to read, but to shorten our time, let me make some comments that occurred to me as I listened to the other testimony.

Probably, looking at my——

Senator BOSCHWITZ. I thank you very much for that. The problem has been stated and restated.

Mr. RADER. All right, let me summarize quickly.

Senator BUMPERS. Listen, you are from my state. You do not have to go quickly, you just take all the time you want. [Laughter.]

Mr. RADER. Thank you, Senator Bumpers.

Senator BOSCHWITZ. But perhaps rather than restating the problem——

Mr. RADER. I understand what you are saying. With my haircut and my age, you probably look at me as an egghead from the university atmosphere. I am far from an academician, I have been the chief executive officer of five small companies; I am on the board of two more.

We are daily out in the trenches fighting for the small businesses and the small manufacturers. I get the impression in this conference that we are riding on a satellite and we are looking down as closely as we can, but everything looks like a large business to us. And we are talking about Technology Transfer, for the most part to large businesses, and only barely have we touched on what it really takes to transfer technology to the small businesses.

Several pertinent comments have been made that it is a person-to-person dialogue, and it is indeed. You cannot publish a lot of information and expect small businesses to grab a hold of it and run into a new product.

Every month I read the National Technical Information Services, the NASA Tech Briefs, and it is a very rare occasion when I find anything that could be of any value to what we normally call a small- or medium-size business.

Once in a while, I find something that is of value to a professor in the university. Our staff of five engineers, 10 people totally, are now taking about 500 requests per year for help. We are out in the trenches working with small businesses. I think some of the statistics quoted today are very valuable, that 85 percent of the metalworking industry is in businesses that have less then 50 employees. Yet, these businesses are not able to use any of the research coming out of NIST in terms of their advanced manufacturing re-

search facility. They have a shop of the 1990s, which is exactly what small businesses need, but unfortunately, the small businesses in the United States cannot all travel to Gaithersburg, MD, to see how the shop of the 1990s is properly outfitted.

They are scared by many of the acronyms that are kicking around now: CAD and CAM and computer-assisted this and that. Very few of them know how to turn a computer on, let alone have a computer-integrated manufacturing shop.

What we need today is about what Japan is doing with their large number of Technical Extension Centers. In a small country like Japan, any business must be within a few blocks of one of those Technical Extension Centers. The Holling's bill which became part of the Omnibus Trade bill, originally requested $94 million be appropriated to NIST to establish 12 regional Manufacturing Technology Centers. Only $4.5 million was appropriated last year. This year they are going to $7.5 million, which will be three more centers and $1 million each for the existing centers.

NIST has been appropriated about $900,000 to establish Technical Extension Centers in the country. If we could take only 1 percent of the money that our Federal laboratories have been appropriated—$62 billion, to put in Technology Extension Centers—I think it would be of tremendous value.

I dwell quite a bit in my written report on our productivity compared to Japan. In 1988 our productivity improvement was 3.2 percent. Japan's was 7.65 percent. Every year, we fall further behind Japan.

Senator BUMPERS. In 1989 that is .9, less than 1 percent productivity in this country.

Mr. RADER. I have not seen the 1989 figures.

Senator BUMPERS. They just came out yesterday.

Mr. RADER. That makes it worse than ever. Every year that goes by, we are falling further behind in productivity, because our rate of growth is less than 2½ times as good. And when the Federal Government, looking from the satellite, sees this, they say let us put more money in research.

Research is great, but many times we expect products to come out of the Federal laboratories research. But probably a new product will not be available for 10 years, and it will probably come out of their communication with large industries. We need to get into the battle on the front where it is happening. I think our loss in productivity relative to Japan is not happening in the big businesses, General Motors and the computer industries and the other large industries are now highly automated. Productivity improvement must come in the improvement in productivity in the small businesses. If we could get the same productivity improvement in small businesses, to bring them up, not to state-of-the-art, but to off-the-shelf technology, there would be a tremendous increase in productivity and we would catch up with Japan and Germany in very short order.

I think I have summarized my comments. Thank you.

[The prepared statement of Mr. Rader follows:]

PREPARED STATEMENT BY WILLIAM H. RADER
Director of the Arkansas Center for Technology Transfer

Before the Committee on Small Business
United States Senate
March 8, 1990

I am honored by the request to appear before this committee to present my views on Technology Transfer as it applies to small business. The activities of the Arkansas Center for Technology Transfer (ACTT), of which I am the director, are performed almost exclusively in Arkansas. I feel it is pertinent to my testimony to give you a brief description of Arkansas.

Arkansas as a state may best be described as a microcosm of the nation as a whole where two cultures exist, a rural and an industrial. If a line were drawn from the Northeast corner of the state to the southwest corner, everything in the northwest half is a part of the Ozark Mountains and has most of the manufacturing in the state. The southeast half of the state is part of the Mississippi delta region. Farming there is the predominant industry where rice, cotton and soybean are the major row crops. The vast pine forests support the lumbering industry and paper mills. The value added from products of this half of the state is essential to the economy of the state.

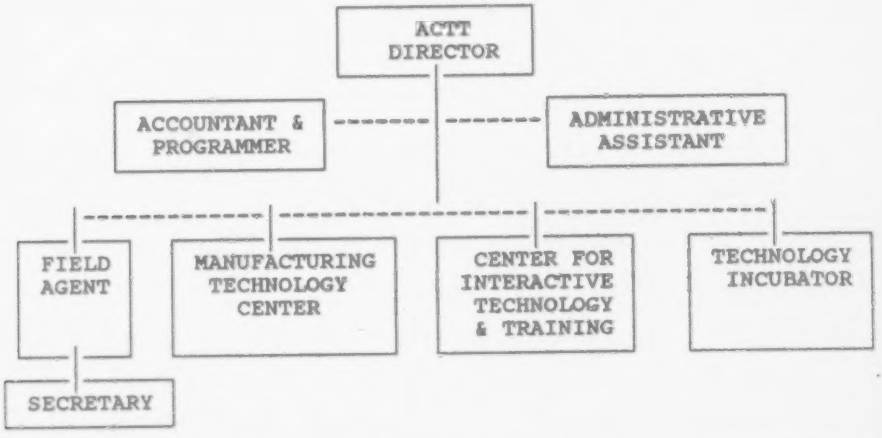
Industry in the northwest is located largely in urban centers in the state, led by the Little Rock Metropolitan area, the capitol of the state, followed by the western corridor including Fort Smith, Fayetteville, Springdale, Rogers and Siloam Springs. In the northeast corner, Jonesboro and Blythsville are also industrialized. In the southwest corner of the state, Camden is strong in defense industries. Agriculture in the northwest half of the state consist chiefly of poultry, cattle and orchards.

Like the rest of the nation there are many "high tech" industries including large and small businesses. Some of the industry is a result of movement from the north and northeast to take advantage of the lower labor rates of Arkansas. Examples would include Whirlpool, Emerson Electric, AT&T to mention a few, and a host of sewing companies. Most of the latter have moved to Mexico or the Caribbean and the Far East. It is significant however that Capitol Mercury, a garment plant which is highly automated has five

profitable plants in the state.

Arkansas' Governor Bill Clinton and the General Assembly have done much to promote economic development in the state. The Arkansas Industrial Development Commission (AIDC) and the Arkansas Science and Technology Authority (ASTA) as state agencies do an outstanding job with limited resources in their mission of attracting industries to Arkansas and funding research, respectively.

Before discussing the effectiveness of the technology transfer programs let me explain briefly the program at the College of Engineering at the University of Arkansas in Fayetteville. With economic development funds spread politically across the state, the University's Arkansas Center for Technology Transfer (ACTT) got its start four and one-half years ago with an annual funding of $278,000 which has not been changed in the four years of the program. Whether funding continues depends on state revenues, pressure for other programs and the whim of the legislators. To understand how technology transfer is achieved let me describe our operation. Below is our organization chart.



- A single field agent, an industrial engineer, has his office in Little Rock and covers much of the state from that central location.
- The Manufacturing Technology Center (MTC) was originally formed in 1983 as a Robotics and Automation Center and has since changed in title. Its

director is an industrial engineer with industry experience. A mechanical engineer with a MS degree and industrial experience is our design engineer and a mechanical engineer with his doctorate is our CAD/CAM and artificial intelligent expert. MTC currently employs twenty-one engineering students and graduate students, usually half time. These students are one of our greatest assets and are one of the major reasons an effective technology transfer organizations should be affiliated with an engineering college. With proper engineering supervision they can be highly productive and bring creative solutions to industrial needs. We also have an electronics technician to keep our numerous computers, plotters, printers and electronics equipment functional and staff a machine shop for prototype construction.

- The Center for Interactive Training creates computer controlled video on tape or disc with graphics overlay for industrial and academic training. They also organize and coordinate training classes in a variety of technical course in classroom mode or by telecommunications.
- Our technology incubator named "Genesis" is funded separately by the state through the Arkansas Science and Technology Authority at $125,000/yr. and by the College through space allocation in the Engineering Research Center. They currently have fifteen technology based clients in residence and are growing steadily as the only technology based incubator in the state. They receive their technical support from ACTT, and report to the Director of ACTT.

ACTT currently receives calls for assistance from industries in the state at a rate of 500 per year. One or two days of assistance are usually given without cost. If more effort is required, a detailed proposal of cost and work to be performed is presented for approval. This is one source of industry funding. We also solicit membership in our Manufacturing Technology Center. The $10,000 annual fee provides a measure of free assistance access to Center facilities and attendance at seminars.

Understanding the nature of our state and ACTT, comments on technology transfer as relates to state and federal support, effectiveness and needs may be kept in better perspective.

I. Effectiveness of Existing Technology Transfer Programs

Technology transfer in the nation is funded largely by the state government, as one of many programs to achieve economic development objectives. Technology transfer is not the primary objective in many if not most of these state funded organizations. The smaller subset of the state programs has come to be known as "state technology extension programs". A survey was conducted by the National Governors' Association in 1989 of the FY 1988 federal and state funding of organizations providing business and technology assistance to small and medium sized businesses. It was done in collaboration with the National Institute of Standards and Technology (NIST). For the year studied the total funding was $620 million, 48% or $298 million came from state funding, 23% or $143 million came from federal funding and the remainder from Universities or grants.

Of the total amount only 4% or $25 million was allocated to technology transfer and manufacturing technology research. Half of this amount, 12.4 million, was expended by one organization, the Michigan Industrial Technology Institute, (ITI). And of this amount 49% or 6.1 million was spent on Technology Research Centers and only 47% or 5.8 million on technology transfer. The remaining 12.6 million, some of which also went into research centers, funded to other states, was notably as the follows:

Ohio Technology Transfer Organization (OTTO)	1.50 million
Pennsylvania Technology Association Program (PENTAP)	2.50 million
Georgia Tech Industrial Extension Service (IES)	2.50 million
Maryland Technical Extension Service (TES)	.55 million
New Jersey Technical Extension Center (TEX)	.50 million
New York State Industrial Innovation Extension Service (IIES)	3.20 million
Arkansas Center for Technical Transfer (ACTT)	.28 million
Michigan Modernization Service (MMS)(Not University based)	3.20 million

Though the programs differ in organization, some of them such as ACTT and others, provide only technical assistance, while others include business assistance. All of them, almost exclusively provide assistance with existing off-the-shelf technology. Very little activity deals with state-of-the-art technology.

The program of the Arkansas Center for Technology Transfer (ACTT) was discussed earlier. We are a non-academic department of the College of Engineering which has seven academic departments or disciplines. The University of Arkansas is the flagship University of the state with the only broadly ABET accredited institution in the state with graduate programs in all disciplines leading to a doctoral degree. Thus we are the only institution able to call on professional faculty in engineering when we need assistance in state-of-the-art technology from multiple disciplines, including our departments of Chemistry, Biochemistry and Physics.

Our staff of five full time engineers, an educator, two programmers and an administrative assistant and an electronics technician all are also full time. We occupy 6800 sq. ft. of space in the 170,000 sq. ft. Engineering Research Center, with a large Manufacturing Technology Center laboratory. With a total annual budget of $630,000 excluding the Genesis incubator, our funding is similar to that of other university related technology transfer organizations as demonstrated by the following table:

Percentage of Funding Sources

Funding Source	ACTT	All States, Ex ITI	Total of All States
State	43	57	45
University	15	25	13
Industry	42	5	12
Federal	0	3	7
Other	0	10	23

The impression is generally held, in the federal government and elsewhere in the nation, that most of the industry problems are of a highly technical nature and that industry is seeking state-of-the-art assistance. That impression is grossly in error. Three salient points must be clearly recognized:

- As confirmed in a study of durable goods manufacturers in the Great Lakes region, "of durable goods factories with fewer than 50 employees, more than 85% have yet to introduce a single programmable machine tool. Only 13 percent of the small shops use computer aided design, and fewer than 3

percent have found a use for robots, automated inspection systems or automated material handling". I believe this can be assumed for the nation as a whole.

- Sixty percent of the firms being assisted by state supported organizations have fewer than 50 employees; another 23 percent have 50 to 500 employees. Thus 73 percent are classified as small businesses.
- Programs must emphasize client-directed problem solving rather than pushing out new technology. Like commercial organizations, success is based on market pull as opposed to pushing a product on the market.

How do you measure the effectiveness of technology transfer? It has been measured in a variety of ways; letters of thanks or accolade, improvements in productivity, increased sales revenue, reduced operating costs, increased profits and jobs saved or created. Much of these data, which could be used to measure effectiveness, are considered proprietary by the assisted manufacturers and are unavailable. All programs have been successful in varying degrees. Currently our organization in Arkansas, ACTT, has used only the yardstick of jobs created or saved in a given year. Using this head count and an average statewide income of $346 per week for a manufacturing job, a multiplier of 1.69 for additional personal income from other resulting service jobs created, and an average yield to the state in taxes of 6.14% we have returned to the state treasury $7.28 for every dollar of funding from the state or $3.32 for every dollar spent regardless of the source. With the current rate of requests for assistance and our current budget, we are hard pressed to provide the needed assistance. The increasing rate of requests for help is another measure of our effectiveness. I'm sure other programs are experiencing similar results. Limited contacts with other states confirms this.

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II. The Challenge From An International Economic Perspective

There is the mistaken concept prevalent in the nation's capitol that economic growth is a direct function of dollars spent on research. Thus to expand research, billions of dollars are spent in hundreds of federally owned, federally operated and federally owned, contractor operated research centers and in research funded through the National Science Foundation. Though these billions may be well spent in terms of research accomplishment, it has only a minor effect on the economic strength of the nation as a whole. There are a host of studies which show that increased employment results, not in the expansion of the products from large industries, but from the initiation of small businesses by entrepreneurs and from the growth of small businesses.

Technology transfer, in the mindset of people in the beltway, comes from the push for technology transfer from the federal laboratories. I personally scan the National Technical Information Services (NTIS) monthly reports and the NASA Tech Briefs published monthly, and find it to be a rare event that these research reports are of value to any business in this state. And there are many "high tech" companies in the state. The greatest value of this research is to the military-industrial complex. It is also unfortunate that inventions and patents resulting from federal funding of research are as available to foreign countries as they are this country. And applications of this research are accomplished more rapidly in other nations than in our own. This too is unfortunate but is the result of lower costs of capital in many foreign countries and their emphasis on long term goals as opposed to next quarters financial statement in our industrial culture.

The Small Business Innovative Research (SBIR) program is an excellent concept and is working well. As originally conceived it was planned to increase the percentage of research in federal departments to the SBIR program from the current 1.25% stepwise to 2.5%, but it is currently stalled at the lower level, despite favorable analyses of its value.

The Hollings Bill which became part of the Omnibus Trade Bill was an excellent start at modernizing manufacturing in the nation. As passed, it was to provide $94 million to establish Manufacturing Technology Centers regionally across the country. Instead only $4.5 million was appropriated on a one time basis to fund three centers in the country. Two

of these were already established in regions of high industrialization in New York and Ohio and probably would have succeeded without federal assistance. The third in South Carolina, a relatively poorer state, has produced good results through a consortium of junior colleges and technical training centers in the south. The second years appropriation is not much larger and awards have not yet been made. The concept in the Hollings bill was to establish 12 Manufacturing Technology Research Centers with $8 million each. It would be more cost effective to establish twice as many Technology Extension Centers with $2.5 million capital cost each and $1.5 million for the first years annual operating cost. The operating cost could be phased out in 5 years with state and private funding replacing the federal funding.

The United States is the dominant Military force in the world, policing essentially the entire globe. But, as a result of our inability to balance our budget and our inability to achieve a positive balance of trade, we are falling behind rapidly as a world economic power. The February 26 issue of Newsweek from 1988 data, CIA Handbook of Economic Statistics and U.N. Monthly Bulletin of Statistics, concerning the balance of trade lists the following data:

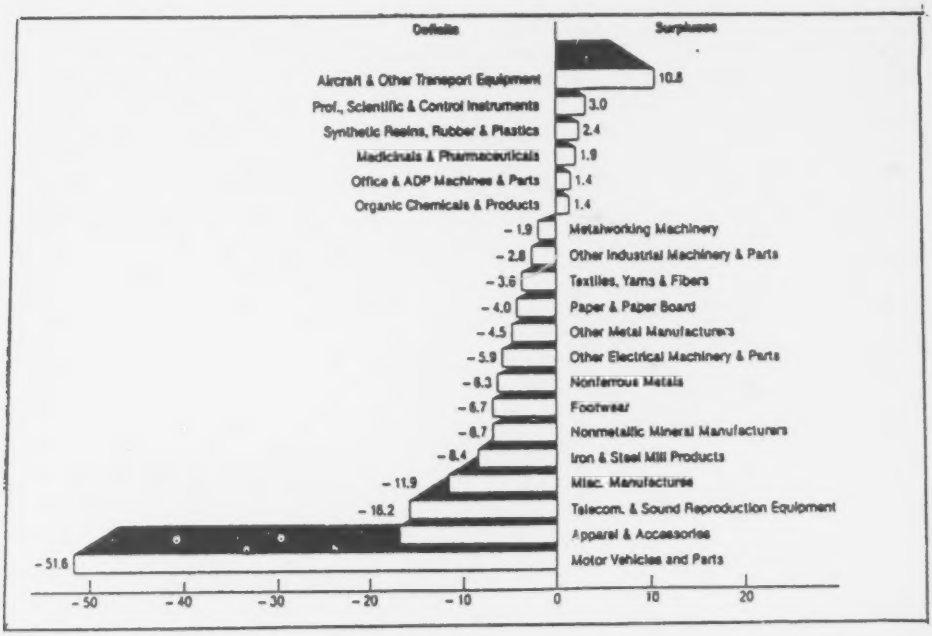
BALANCE OF TRADE

(in Billions of Dollars)

Japan	77.5
United Germany	73.9
Soviet Union	3.3
United States	-138.0

The result of the continuing unfavorable balance of trade is the increasing sellout of assets in this country to investors from other nations. I understand the six largest banks in the world are Japanese, a predictable result.

Unless the industry of the United States can be modernized with proper recognition to quality of product as well as productivity we will indeed become a second rate nation with a reduced standard of living and a declining tax base. Below is a chart published by the International Trade Administration Office of Trade and Analysis, U.S. Department of Commerce, which demonstrates graphically where we have lost our balance of trade.

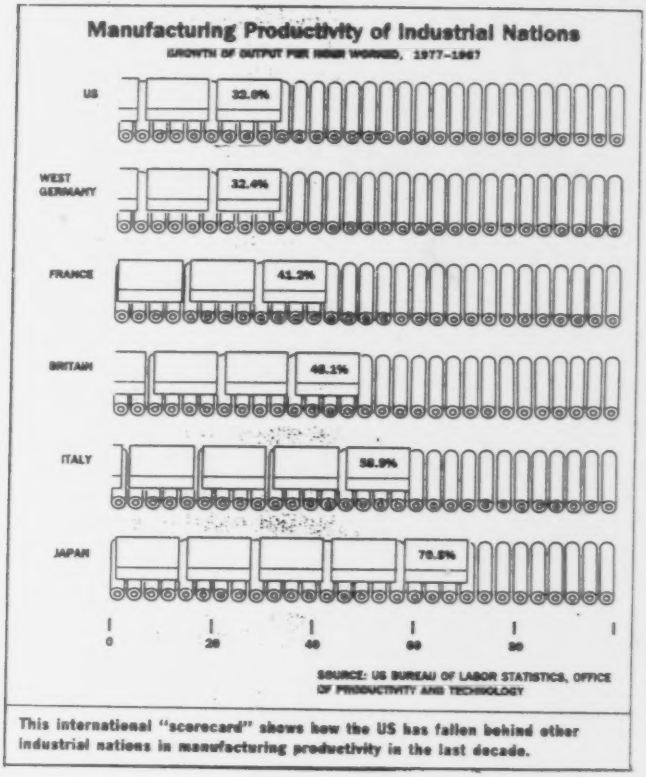


U.S. manufactures trade balances, by commodity groups, 1986, in billions of dollars.

.. International Trade Administration, Office of Trade and Analysis, U.S. Department of Commerce.

Many of the above industries showing deficits are largely small businesses or rely on small businesses for parts in assembly operations. This is certainly true of motor vehicles and parts, miscellaneous manufacturers, footware, other metal manufacturers and apparel and accessories.

It is obvious that our ability to compete has been lost and will be difficult to regain. our poor productivity is further described in the following graph from the U.S. Bureau of Labor Statistics, Office of Productivity and Technology. The graph dramatically pictures our laggard improvement in productivity.

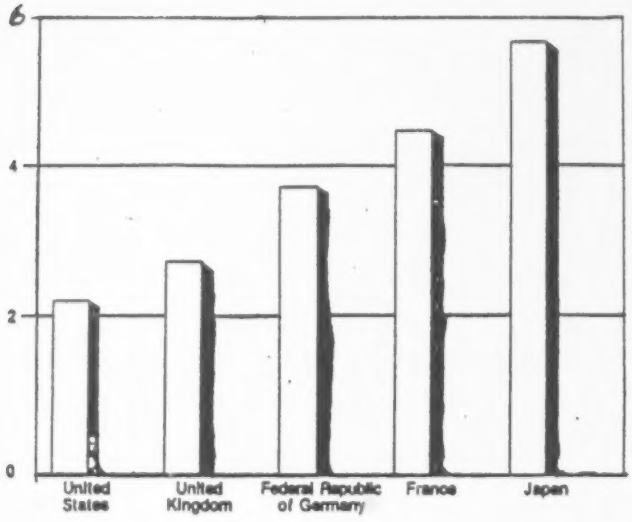


This international "scorecard" shows how the US has fallen behind other industrial nations in manufacturing productivity in the last decade.

The industry of the nation is far too labor intensive. More effective use of labor through flexible automation is a must if the nation is to survive economically. Some analysts would say that the expansion of our service industries is our salvation, but we cannot survive selling hamburgers and insurance to each other.

The lag in the rate of productivity improvement is further shown in the graph below which charts the annual rate of productivity improvement in a 12 year period up to 1985 compared to other industrialized nations.

Average Annual Percentage Change in Manufacturing Productivity Output per Hour Between 1973 and 1985

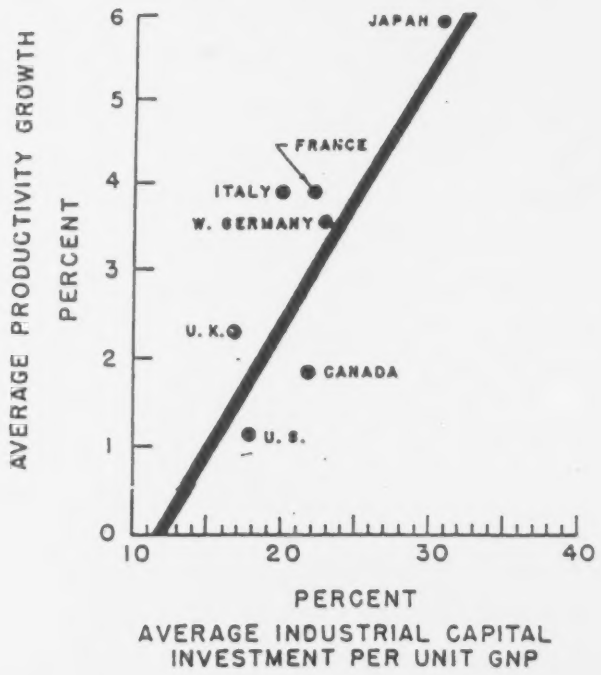


(Source: The Technological Dimensions of International Competitiveness; National Academy of Engineering, p. 21)

For the 12 year period described by the graph, the total growth rate in productivity for Japan was 93.6% in output per hour while the U.S. was 29.8%. Their labor cost in terms of productivity per hour was reduced over 3 times as fast as the U.S.

The increase in productivity is not because Japanese workers work harder. It is a result of industrial capital investment in modern, off-the-shelf manufacturing technology. Their average investment per unit of GNP for the 23 years is 30% while ours is only 18%. This higher investment rate has resulted in a total productivity growth per unit of GNP product of 372%. The U.S. lags way behind with only 28.6% growth per unit of investment. This is well pictured in the graph below.

CORRELATION BETWEEN PRODUCTIVITY GROWTH AND INDUSTRIAL CAPITAL INVESTMENT (1960–1983)



SOURCE: U.S. DEPT. OF LABOR, BUREAU OF STATISTICS, 1984

Not only is our performance poor compared to Japan which increased their productivity growth rate five times as fast as we did, but we also fell far behind the industrialized nations in Europe. This flashes danger signals in our ability to compete with the 1992 European Community.

These data clearly demonstrate our decline as a world power, not because we lag in research, but because we have not applied the results of our research to appropriate manufacturing methods. There is overwhelming agreement among technology transfer program managers that the businesses they assist mostly require access to off-the-shelf existing technologies. Greater assistance must be paid to assisting small and medium sized firms by training managers in the justification of flexible manufacturing equipment and personnel in the operation of such equipment rather than concentrating on state-of-the-art technology that is of little use to most smaller firms. For firms who have yet to make use of personal computers, adoption of any CAD/CAM or CNC equipment is a big step. Most current funding by the federal government in current programs through Small Business Development Centers, from SBA and EDA and many other programs, provide businesses with management and business assistance rather that technology assistance. Business assistance is of little value if your manufacturing equipment is outmoded.

Though Arkansas may be considered a backward state, it has a normal percentage of companies who have embraced modern manufacturing methods. Global Manufacturing in Little Rock is a good example. In 1983 they had several manually operated machine lathes, milling machines, etc. and employed 45 people. They produce devices to rap the side of silos to achieve piston flow down the conical bottomed silos instead of rat-holing. They installed two Japanese machining centers and sold all the old manually operated equipment. As a result they gained three times the production with one-third the labor force. Today they have six flexible machining centers with two more on order. Their quality is such that they have a healthy backlog of orders, are back up to their original personnel complement and 40% of their product is shipped to Japan.

We recently sent out a questionnaire to firms in Arkansas, Oklahoma, Kansas, and Missouri inquiring of the following:

1. Interest in Computer Assisted Design (CAD).
2. Interest in Computer Assisted Manufacturing (CAM).

The high levels of response of 28% despite a not too well screened mailing list was remarkable. Answers were as follows:

1. Response of occasional or frequent interest in CAD was 55%
2. Response of occasional or frequent interest in CAM was 31%

These responses indicated their thirst for information and the decreasing interest as the questions progressively involved higher levels of technology indicating a naivety in regard to todays off-the-shelf technology. It is possible that an even greater percentage of those who didn't respond were computer illiterate and saw no sense in training on CAD or CAM.

III. Evaluation of Federal and State Technology Efforts in Assistance to Small Business

Are the federal and state programs meeting the needs of small business? The answer must be a resounding NO! The current funding of "R & D" makes three assumptions which are all faulty.

1. Assumption Number One. Increased funding to research in the federal laboratories whether federally operated or contractor operated will assist the nations economic growth thus reducing the balance of trade. So called technology transfer from these laboratories are only very rarely of any value to small businesses. They are of value only to very large companies who have their own research or are members of the military industrial complex and to competitive industrial nations. If they have commercial value, industries in countries such as Japan and Germany can reduce them to commercial products faster than the U.S. can. Occasionally I find research of value to our researchers in the University and pass them on.
2. Assumption Number Two. Increased research funding through the National Science Foundation (NSF), who received $1.665 billion in 1988 will be readily reduced to a commercial practice. Though we normally speak of research and development (R & D) NSF constantly advises proposal writers that they do not fund development. The use of the word development will automatically kill a proposal. Only recently with a Directorate for Engineering have they started to consider applied research. NIST is outstanding in its development of advanced manufacturing and automation, but the developments are of little or no value to small business.
3. Assumption Number Three. The big need of small business is business assistance. The federal government through agencies such as the Economic Development Agency,(EDA) the Small Business Administration (SBA) and others funds Small Business Development Centers (SBDC), Small Business Institutes (SBI) and others, but funds very little in technical assistance. Of the total funding in 1988 of $620 million, $596 million went to business assistance.

A multitude of studies have shown that economic expansion will come from the establishment of new companies and the growth of small companies. Whether these new and expanding companies are more efficient producers of parts or producers of better parts purchased by large assembly companies such as automotive companies or producers of innovative products, the dominant need is for technical assistance with off-the-shelf technology. This assistance must result from market pull rather than an attempt to sell the state-of-the-art to small companies who are just getting acquainted with personal computers.

This is best accomplished in university assisted technology transfer centers which can accomplish the following:

- Provide productivity assistance through proper automation.
- Provide statistical process control training and assistance.
- Provide design assistance for conceived products.
- Provide assistance in plant layout and equipment specifications.
- Provide demonstration facilities of off-the-shelf components and shared time facilities to prove the value of Computer Assisted Design (CAD), Computer Assisted Manufacturing (CAM) and Computer Integrated Manufacturing (CIM). Such facilities could also be used to make prototypes for the entrepreneur with a conceived product.

Wealthier states such as Michigan, New York, and Pennsylvania, with concentrations of industries, have been able to afford such facilities with a small fraction of their annual budgets. However, most states in the same position as Arkansas are becoming similar to third world nations as the haves get wealthier and the haves-nots fall behind in relative standings. To avoid falling further behind the nations with positive trade balances, the nation as a whole must improve its economy.

Increases in federally funded research has not and will not solve the economic problems and trade balance. The following suggestions for economic growth of the nation through modernization of small business facilities are made after a great deal of analysis and thought.

1. Create a national network of Technology Transfer Centers similar to the successful agriculture extension centers with at least one center per state with more in some states depending on size and geography. Agricultural Extension Service in 1988 was funded by $1.5 billion. The time has come to assist small businesses as was found necessary years ago for agriculture.
2. With very little lobbying on the hill to speak for technology transfer to small manufacturers the government needs to recognize its crisis in manufacturing as it pertains to small businesses in the nation. The Southern Growth Policies Board is starting in a small way to address the publicity needed.
3. Fund the development of Technology Transfer Centers to capable universities with challenge grants to the states for the capital expenditures required to establish the centers and for operating funds.
4. When the original Hollings Bill, which became part of the Omnibus Trade Bill, visioned $94 million to Manufacturing Technology Centers around the country, only $4.5 million was funded. If $1.5 billion were funded with state matching funds, several hundred such centers could be established throughout the U.S. Such an amount though seemingly large is dwarfed by the $14.5 billion in payments in government programs benefitting agriculture in 1988. If Egypt can be supported by $1.5 billion in grants and $2.0 billion in credit, certainly our own economy is worth $1.5 billion.
5. Establish a low interest loan program to small business manufacturers at less than the prime rate to modernize their facilities and permit accelerated depreciation to provide cash flow to retire the loan rapidly. The fund would be a rotating fund which could be reinvested in other companies as the loans are retired. The fund could be administered through the Technology

Transfer Centers to be audited by the universities and the Government Accounting Office (to avoid a HUD experience). All equipment purchased would be required to be of U.S. origin which would further increase national employment and prosperity. If the loan for equipment purchased becomes in default, the equipment could be reclaimed and placed in another company, which would assume the mortgage.

6. Encourage with federal funding the establishment of technology based incubators, which, based on little history to date, have a success rate of 80%, while the new company failure rate, without incubator support, is 80%.

7. Pass legislation to continue to increase the 1.25% share of research to the SBIR program until it reaches at least the earlier planned percentage of 2.5% Small businesses are a source of creative and innovative thinking. This nation must foster and use such creativity.

Such a program would have tremendous pay back in economic development, national prosperity, and the balance of payments. The moderization of the nation's small businesses would have a very positive effect on the reduction of the national debt. Without meaningful help we may look forward to a reduced standard of living and unemployment that would be like a continuing recession without the revenue to attack problems of drugs, the environment or education.

Your first reaction to the foregoing proposed solution to the nations economic ills would be to class me as another egghead from an academic environment. On the contrary, with 30 years in industry, I have been the CEO of five small businesses, have been on the board of two more and have been a management consultant to several more. Involved in economic development in Arkansas I am aware in detail of the problems of many small companies in the state. I recognize the budget problems between the Federal legislators and the president as well as the problem of state legislators and governors, but firmly believe the problems of small business must receive greater attention. Small businesses are the largest employers in total in the country and are our greatest hope for expansion and competitiveness. There is a real national problem which won't go away. If ignored, it will only become worse.

ARKANSAS CENTER FOR TECHNOLOGY TRANSFER
Engineering Research Center
West 20th St.
Fayetteville, Arkansas 72701
Ark. Wats 1-800-334-3571
(501) 575-3747

UNIVERSITY OF ARKANSAS • College of Engineering

March 21, 1990

Ms. Tracy Crowley
United States Senate
Committee on Small Business
Washington, D.C. 20510-8350

Dear Ms. Crowley,

I appreciate the continued interest in the Arkansas Center for Technology Transfer by the additional questions submitted by Senator Malcolm Wallop of Wyoming. The Senator asked two questions:

Question #1. What efforts have you undertaken at your center to create a demand for technology transfer?

Our center was created almost five years ago when we realized there was a pent-up need for technical assistance by small business. As soon as our organization was started with two professional engineers, we did several things to advertise our availability.

a. We contacted the Arkansas Industrial Development Commission to tell them of our availability and commitment to economic development in the state.
b. We wrote to each of the eight Planning and Development District headquarters in the state advising them of our availability and mission.
c. We had an in-state 800 number installed so that a phone call for assistance would be free from anywhere in the state.
d. I was given a few minutes on educational television to tell of our mission with a short video of our robotics and automation laboratory.
e. From that early start, we have relied on our reputation for increased activity.

It must have been effective, since we now keep five engineers, five other salaried employees and twenty-one part time students and graduate students so busy that we have trouble carrying the work load.

Question #2. What industries have been effected the most by your technology transfer assistance?

This can be answered in a number of ways. Let me answer it from several points of view.

a. A little over three quarters of our calls for assistance come from four major manufacturing categories.

Of these the percentage of distribution was:

- Miscellaneous manufacturing 27%
- Metal working machinery 26%
- Professional Scientific Control instruments 19%
- Synthetic resins, rubber and plastics 18%

b. Of all manufacturing:

- Sixty-two percent (62%) were established companies requesting various types of assistance from automation to quality improvement and to assistance in new product development.
- Thirty-eight percent (38%) were from entrepreneurs who were developing innovative products and needed help in design, manufacturing methods or cost estimation.

c. From the stand points of the size of the companies assisted, the pie chart on the following page defines size of company well. Eighty-nine percent (89%) were less than 500 employees and almost seventy-five (75%) were less than 100 employees. An additional pie chart shows another classification of assistance provided.

d. In the last fiscal year, we were instrumental in creating 919 jobs in small businesses in the state through either expansion of existing small businesses or through assisting entrepreneurs in initiating new businesses.

I sincerely hope this answers the questions asked. If you have any further questions, I would be pleased to answer them.

I can't emphasize too much the value of small business to the economy of the country. Yet the federal legislature leaves them essentially ignored as we pour billions of dollars into research benefitting largely the military industrial complex. Attached is a copy of the cover page for the monthly publication of the National Center for Manufacturing Sciences, which describes graphically the importance of small business. Please note also from the article that "about 80% of new technology is first introduced by new, often small ventures". Though there is abundant Small Business Development Centers, "SBDC", financed from federal funds through EDA or SBA, who assist form a business standpoint there is little or no technical assistance financed by the federal government. The only technical assistance that is offered is by the wealthier highly industrialized states.

The Senate Small Business Committee is the only hope I can see for establishing any technical assistance to entrepreneurs and small businesses to develop new technologies or increase productivity.

Sincerely yours,

William H. Rader

William H. Rader, Director
Arkansas Center for Technology Transfer

National Center for Manufacturing Sciences

FOCUS

Vol. 3, No. 2
February 1990

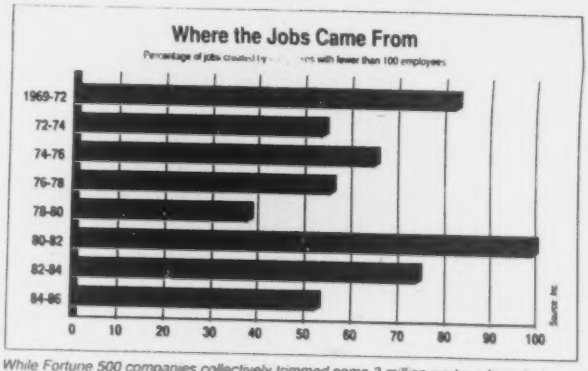
America's small businesses face big competitiveness concerns despite prosperity

The 1980s saw the emergence of the "little guy." From job growth to innovation, small business dominated America's employment landscape — setting a trend that's likely to continue into the 90s, and one that's forcing economists and big businesses alike to take notice.

Recent statistics show that while Fortune 500 companies collectively trimmed some 3 million workers from their payrolls during the first half of the 1980s, small businesses created about 7 million net new jobs in the United States.

Today, small business continues to lead the way in job growth and profits. *Nation's Business* reports that firms with fewer than 500 employees produce nearly half of the country's goods and services, and they employ roughly half of the private workforce.

This new, dynamic economy has also been credited with fueling the engine for economic revival and technological innovation. Although industries dominated by big companies are generally thought to be more innovative, it's actually the small companies in those industries that are more likely to produce the innovation. In fact, about 80 percent of new technology is first introduced by new, often small ventures.



While Fortune 500 companies collectively trimmed some 3 million workers from their payrolls during the first half of the 1980s, small businesses created about 7 million new jobs in the United States.

Clearly, America's small businesses are on the cutting edge. And their owners are generally optimistic about the future. But the size of a company has a critical impact on its ability to respond to competition. And small U.S. companies, despite substantial growth, seem to have even more competitiveness concerns than their larger counterparts.

This issue of FOCUS examines in detail the special dynamism of America's small businesses and the competitiveness concerns they will be facing in the 1990s. Three executives of leading-edge entrepreneurial firms — Howard Greis of Kinefac Corporation, Rick Dove of Savoir and Larry Rhoades of Extrude Hone — share their views and experiences as small businessmen, and explain how membership in the NCMS has helped them in their efforts to remain competitive.

In addition, this month's Washington Report looks at attempts to create a U.S. Quality Institute, which will benefit both small and large businesses by providing the individual, human and organizational skills necessary to compete for the Malcolm Baldrige National Quality Award.

In This Issue . . .

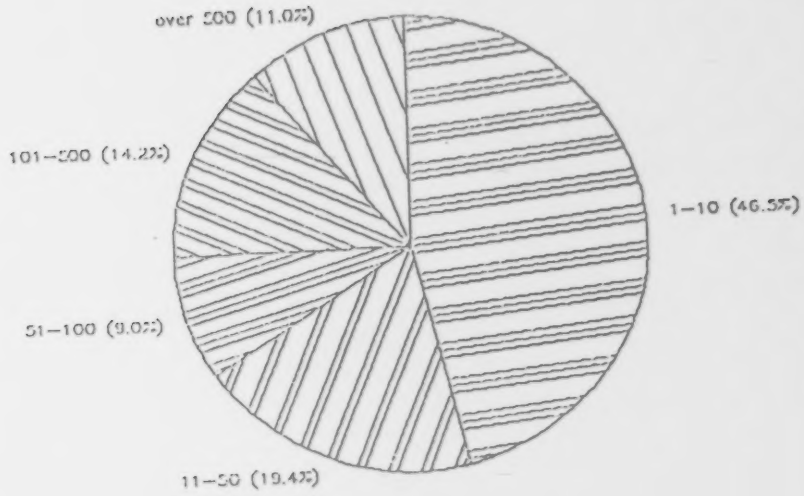
NCMS' role as a manufacturing science knowledge broker

Entrepreneurial firms find critical tools for staying competitive

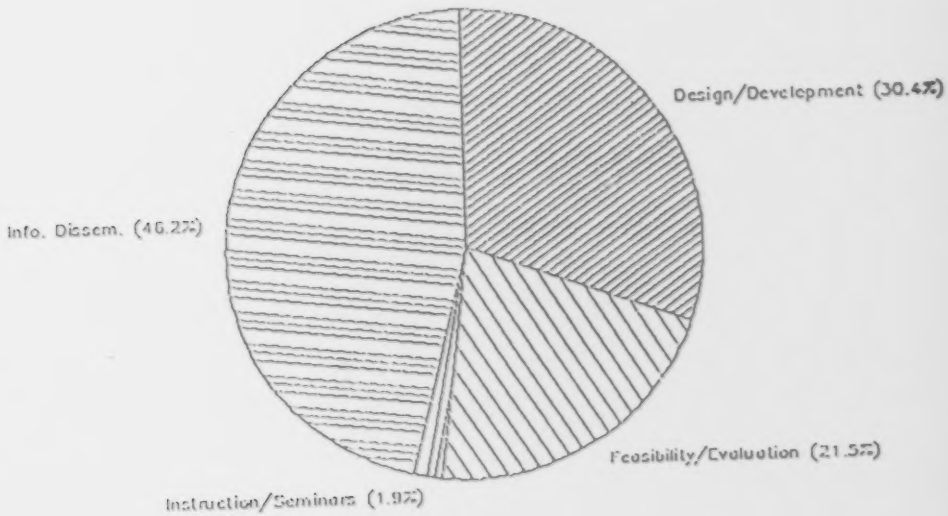
A forum for the collective needs of small and large companies

Quality institute to boost U.S. standards and performance

No. of Employees vs.
Percentage of Projects



Classification of Projects



Senator BUMPERS. Senator Boschwitz, just on the point of personal privilege, and I am going to have to run.

Bill, I want to tell you that was a magnificent statement, and I am so pleased with it. Herman Talmadge, and I were together someplace and somebody made one of these big, high-faluting speeches, you know, that nobody there understood, and we suspected that he did not either. And when we left, I said, Herman, what did you think about that speech? He said, Dale, it has been my experience that if you want people to understand, you have got to throw the corn where the hogs can get to it. [Laughter.]

And so oftentimes we just do not get information that is understandable, translatable into our duties and jobs here. Your statement does that, and both you and Mr. Shuster touch on several important things,

Mr. Shuster, I have just read an article which was given to me by Senator Boschwitz which shows the magnificent work you are doing out in Minnesota.

But I want to say, Bill, especially to you, the Federal Government is putting $60 billion to $70 billion a year in research, and I dare say that small business is not getting 1/100 of 1 percent of that.

Mr. RADER. Or less.

Senator BUMPERS. But your point on productivity at the end of your statement was the most cogent of all. We are not ever going to catch the Japanese. First, you know about 30 percent of our scientists are involved in defense, and they have about 1, maybe 2 percent of their scientists involved in defense.

People talk about that as though that is some cosmic event happening out in space, that we are not really related to our productivity problems and our trade problems. It is totally related.

But then, I am not going to get preachy. I want to thank both of you, and I apologize for having to run—Bill especially—but we thank you very much for coming.

Mr. RADER. It was a pleasure to attend.

Senator BUMPERS. Thank you, Senator Boschwitz.

Senator BOSCHWITZ. Thank you. And now we turn to Mr. Bryant.

STATEMENT OF McRAY C. BRYANT, STATE DIRECTOR, WYOMING SMALL BUSINESS DEVELOPMENT CENTER NETWORK

Mr. BRYANT. Thank you. I am Mac Bryant, the State Director of the Wyoming Small Business Development Center Network, and I do appreciate this opportunity to speak before you. I have timed myself and I am 6 minutes, so I think you can relax. I hope you can.

Wyoming is a distinctly rural State, and although we are certainly one of the larger States in geographical area, we now have the distinction of also being the smallest in population, so we have some different needs that I think you will appreciate.

Because of that, any current or potentially available Federal Government initiatives will very noticeably affect our small businesses and those in States similar to ours.

I would like to focus on one particular aspect of Technology Transfer, namely, technology development. Technology cannot be

ultimately transferred if it is not first given the opportunity to be properly developed. Small firms, as you have heard earlier today, traditionally tend to be very creative and innovative by nature. Many of our country's greatest technological inventions have come from individual entrepreneurs or small firms. It is, however, becoming increasingly difficult for small businesses to properly develop their new technology due to a shortage of funding, evaluation expertise, and testing facilities, at least in their eyes.

These shortages are especially noticeable in rural States with recessionary economies, such as is the case in Wyoming and surrounding States. We do not have any Federal testing labs, and only until very recently have we even had a small State program with a tiny budget to assist in developing technological innovations. Because of its tiny budget, its focus is, necessarily, incredibly narrow, and it does not even yet have a full-time director, thus its impact is severely restricted. Its future, however, is very promising if funding can be increased.

I am pleased to say, however, that the Federal Government has created a friend to small business technological innovation. NIST, the National Institute of Standards and Technology, the Federal laboratory within the Department of Commerce, has developed a very helpful co-op program funded by the U.S. Department of Energy called the Energy-Related Inventions Program (ERIP), in my terminology.

The Wyoming SPDC has been a Pilot State SPDC for this program for 2 years. We were most pleased to be designated as a Pilot State because we have a dearth of invention evaluation resources and grant money. Several of our clients have utilized the NIST evaluation service, and I am pleased to say that it appears that one of our clients, Mr. Pete Minor of Casper, WY, may receive a $140,000 grant from the Department of Energy. That is a slight change from my written testimony. His innovation will dramatically improve our ability to save lakes that have been contaminated by acid rain. In doing so, it will save energy and solve an international environmental problem. His process is much quicker and much more efficient than current methods of dealing with this critical problem.

[Information on the referenced grant follows:]

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
(formerly National Bureau of Standards)
Gaithersburg, Maryland 20899

September 12, 1989

Mr. A. Jack Vitullo
Director, Invention & Innovation Program-CE-122
Conservation and Renewable Energy
Department of Energy
Forrestal Building, 5E-052
Washington, DC 20585

Dear Mr. Vitullo:

We wish to call your attention to an invention entitled "Mud Devil - Deaerator Mixer" submitted to us by Mr. Steve Elledge on behalf of Mr. R. M. Miner for evaluation under Section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974. Our evaluation has been completed and we recommend Mr. Miner's invention as technically valid and worthy of consideration for appropriate Government support. The enclosed evaluation report is provided in support of our recommendation.

The invention is an apparatus for mixing and deaerating drilling mud prior to injection into the oil or gas well being drilled.

Second-stage analysis was conducted by Mr. Jimmie L. Olson; his report is included under Tab B. The final technical review by Mr. J. S. Dhillon of the OERI staff is given in Tab A. Material submitted by the inventor is given in Tab C.

If you have any questions or would like additional information, you may contact Mr. Dhillon who has been assigned as staff coordinator for the invention. A copy of our letter of notification to Mr. Miner is enclosed.

Sincerely,

George P. Lewett
Chief, Office of Energy-Related Inventions

Enclosures

cc: Mr. Steve Elledge

Mr. BRYANT. Our delight with the NIST DOE Program is tempered by the fact that it is available for energy-related technological inventions only. Nonenergy innovations, are of course just as valid and needed just as much as energy related inventions. NIST, however, has no funds in the ERIP Program to assist in that area, though it is certainly fully qualified to do so. The expansion of the ERIP to cover other than energy was authorized, I understand, in the Omnibus Trade Bill, but has not yet been funded.

It is my suggestion that $2 or $3 million should be allocated to the NIST Innovation Evaluation Program, to work with small businesses and the individual inventors, their technological inventions and new product development. Again, I believe that NIST is very well qualified, from our experience, to administer such a program, and assistance is desperately needed in rural States such as Wyoming.

The Small Business Development Centers are well equipped to work with NIST on such a program, as we have many clients needing the service and an infrastructure in place to help. Allowing NIST to aggressively assist all inventors in this way cannot help but bring America back as the leader in research innovation and the commercialization of new technologies. Our small businesses are certainly not short of ideas and creativity. They are just short of a little assistance to help them in developing their good ideas, which will ultimately lead to more Technology Transfer in the United States. Funding such an assistance program at NIST will help.

Senator BOSCHWITZ. I am going to turn it to Senator Wallop, who has told me earlier that he has some time constraints.

Senator WALLOP. Mac, I want to welcome you here and also tip my hat to you for the job that you have done in Wyoming with the Small Business Development Centers. It has been no easy task getting small businesses just, for one thing, to respond to the "I am from the Government, trust me" kind of effort that you have had to undertake.

Let me ask you this, as you described it, you have been describing something slightly different than others here have been. They have been describing how the national labs cooperate with somebody. You are talking, in large measure, like Mr. Minor's invention, of something that has been invented, not in the lab, but is there ready for evaluation and development. There is sort of two different things at work, neither of which seems to be entirely efficient.

Could you comment on it as how you see it possible for a Wyoming small business, for example, to find any of the 762 national labs with which to cooperate, versus the other thing, you have somebody who comes in and says look, I have got this thing, how do I get somebody to pay attention to it, evaluate it and see if we can put it into production?

Mr. BRYANT. Taking your second aspect of the question first, I am really impressed with what NIST is doing with the energy-related programs. It works great in Wyoming, and can only work better as we mature. I think, though, it is very important to have that available for nonenergy related inventions as well.

Senator WALLOP. Do you like Mr. Shuster's idea or Mr. Rader's—I cannot remember which—of the National Technical Extension Service, would that fit in?

Mr. BRYANT. That and also just what NIST is doing now long distance. It would be incredibly helpful, but the only one we can refer to them are energy related. We have a lot of inventions in Wyoming that are not energy related, but we do not have a large budget or many analysts in the State that are technically qualified to help. So, we can just tie into current resources, if only there were a small amount of funds allocated to a very good program in the nonenergy area.

The first part of your question, I think, refers to how would we tie into, perhaps, the transfer mechanisms, and I researched and only have now just found out there is a testing lab in Boulder, CO, which is the closest to Wyoming.

So I think as we are developing today, a little more publication, a little more communication of what is now available and a little more priority about how do the little people tie into it. The SBDCs are a good way to disseminate that information, but we do not even know, so perhaps that is our fault and I should not admit that.

Senator WALLOP. Well, you have to admit it. Otherwise it is damn certain you will never get there. The first step would be to know what you do not know. That seems to be at the nub of it.

As I understand the other witnesses, you know, is to try to find the means by which people can; one, be made aware of it and then assisted in taking advantage of the technical innovation that the country already has in hand, as well as for the country to discover the technical information that the public has in hand that it is not aware of. It seems like you have got two problems that are sort of the same, but require different treatments. Is that a fair statement?

Mr. BRYANT. I would certainly agree.

Mr. SHUSTER. I think in that respect, it is very difficult to—for Government agencies—find small business or anybody, so the problem is to make it very possible and convenient for businesses to find you—appropriate labor Federal agency—and I think that is really important. For example, the super strong polymer discovered in West Virginia, people in Wyoming should know about it, people in New Mexico, all over the country, and all American structural engineers should know about it. They will find you because they have the need—if there is the convenient access discussed above.

But trying to push some of these things out is very difficult. It is an almost impossible job, and I think people trying to do it cannot be faulted because it simply does not work, and it is too difficult.

Senator WALLOP. So, that is where the Extension Service kind of concept comes in, as well as the book with the 1,000——

Mr. SHUSTER. Yes. Right now our company—we are going to continue with Technology Transfer, regardless of what happens in Washington—but our company right now is helping some company in America through a critical path, technical problem every 3 minutes of every hour of every day. They want to know what kind of a polymer to use. They want to know why their paint is falling off, they have a plating problem, and so forth.

And that is another thing. I am hearing a lot about Technology Transfer today and what I am really hearing about is intellectual property transfer, which is only a part of Technology Transfer. Technology Transfer can be just a simple technical answer. What kind of—can I drill a hole with a laser, and what would be the characteristics of that hole. It is not licensable, but it may do a hell of a lot for the company needing the answer to that question.

And I can tell you this too, that when Representative Wyden was talking about $4 million being the return on your investment in Federal research, I can tell you that the return is really a lot greater than that, because of the casual interaction between lab people that go to conferences, and business people that go to the same conferences.

After meeting at a conference, the first company I started worked with the lab in Boulder. It is a low-temperature laboratory, and we also got help at a conference from one scientist from Los Alamos that probably saved our corporate life. Now, I do not know what that is worth, and it will never get into any statistic. The company today has sales of $120 million a year, and one-third of it is exported.

Senator BOSCHWITZ. What company was that?

Mr. SHUSTER. Minnesota Valley Engineering (MVE).

So, it is hard to get that into statistics. You have to be very bold and very aggressive to find help. So, I think the problem is to make it as easy as possible for whoever needs help to get it conveniently right at their desk.

Senator WALLOP. We are spending too much time worrying about the statistics and not enough time worrying about——

Mr. SHUSTER. The whole process is very difficult to quantify. I mean, what is it worth to save a company? What is it worth to have a new product? It is very difficult to quantify it. And you cannot say that because I gave this person some piece of technology and they became very successful with it, that that is a really good transfer. And if I gave somebody else another piece of technology, but the market shifted on them, and consequently they had no apparent benefits, that that particular transfer was a bad one.

They are all good, and the only way you can really determine the value of Technology Transfer, and we are doing this in our company, is statistically. We are finding out that of the pieces of technology or know-how being transferred, 7 percent result in value to the recipient company of over $100,000. We do not quantify value higher than that. You cannot say the other 93 percent are bad. They really are not, they just have variably less value.

Senator BOSCHWITZ. Could you describe for both of us exactly what your company does? You did not describe that quite completely. How did it begin? Did it begin from your own experience?

Mr. SHUSTER. I started a low-temperature manufacturing company in Minnesota. We had very limited resources and we had to compete against a Fortune 100 company. We soon determined that the battlefield was technical.

So what I did is I actually went around the country and found experts in each narrow piece of technology that was important to us, and just to make a long story short——

Senator BOSCHWITZ. You were making containers for——

Mr. SHUSTER. We made liquid oxygen systems for emphysema patients. We made liquid nitrogen containers to store bull semen for the artificial insemination of cattle. We built the cryogenic—low temperature—pipeline going up the gantry for the space shuttle.

Anyway, with our limited in-house resources and this cadre of experts, we came to dominate the market in 10 years. I subsequently sold the company to Beatrice Food Co. and retired, and helped a couple of other small companies get started. Based on my experience at MUE, I was intrigued with the idea of America having a knowledge commons.

So I wrote a business plan that looked kind of like it could make sense. I took a trip around the country, and everybody, including people here in Washington that I visited said do it, it is a good idea.

So I started Teltech, put the necessary knowledge infrastructure together, keeping our focus always on the technical knowledge needs of the client. We do not really care what goes on in national labs. We do care about it only if it can help a client.

So anyway, when we went back to the marketplace, we had a very difficult time of it because of the culture issues. We learned that you have to be sensitive to the psychological aspects of Technology Transfer, or you will not be successful.

I can tell you that when one company was approached about buying our services, the president of the company wanted it, and all the engineers wanted it. The chief engineer did not want it. When we asked his subordinates, "Why do you suppose he does not want to take this service." They replied, "Because some of his pet theories might fall." Now, you have to be sensitive to that. There are a lot of psychological issues that have to be dealt with when trying to design an effective Technology Transfer Program.

So, besides clients being able to talk to experts around the country, our service also brings the libraries of the world right to the client's desk, regardless of where they are located in the United States, through the process of remote interactive literature searching.

Teltech service allows a user to search the world's patents right from their own desk whether in Wyoming or in Black Duck, MN, in fact. Thus the comment that this kind of service represents the first time in history that small and start-up companies and particularly rural companies can have equal access to the knowledge and information they need to grow and prosper.

I do not think you are going to get a lot of economic development in rural communities until you put a knowledge infrastructure out there.

So when I said or suggested that every technical person could be a technology center, I really meant that. The NTES's service proposal will give every appropriate person, no matter where he is, access to thousands of experts across the country. He can call these experts any time he needs them. The service makes it easy for him to find them and, of course, also permits each user to search the world's literature right from their desk.

So this is what we do—Technology Transfer. We have made a business of it. It was very difficult. We did not make plans for

about 3 years. We spent about $4.5 million learning some of these things, and now our business is moving along very well.

Our renewal rate, by the way, is over 90 percent for the service. Another point is that if we do not do the job, if we do not help our clients technically, our clients kick us out.

Senator WALLOP. It is very exciting, I appreciate it.

Senator BOSCHWITZ. I am glad that we had the opportunity to air that, and I thank the panel for coming this morning.

This hearing is adjourned.

[Whereupon, at 12:03 p.m., the hearing was adjourned.]

APPENDIX

MEMORANDUM

Date: March 14, 1990

To: Senator Dale Bumpers, Chairman,
U.S. Senate Committee on Small Business

From: Mr. Peter Fitzpatrick, Executive Vice President, and Dr. Frederick Rothwarf, Science Advisor, Virginia's Center for Innovative Technology (CIT)

Subject: Statement for the written record prepared by the Virginia Center for Innovative Technology (CIT) concerning the March 8th hearing on problems associated with commercializing federally developed technology.

Senator Bumpers:

Thank you for the opportunity to submit written testimony to your Committee. The following are written responses to several questions which CIT believes are pertinent to federal laboratories providing better access to federally developed technology with the ultimate goal of commercialization in the private sector. Such efforts have been mandated by various laws, especially the Federal Technology Transfer Act of 1986.

I. Virginia's Center for Innovative Technology (CIT): An overview of its activities

The Center for Innovative Technology (CIT) has advanced Virginia's economic growth since its inception in 1984 and today provides technology leadership within the state. CIT has leveraged its funds through the establishment of innovative programs and the formation of industry/higher education partnerships to develop, transfer, and commercialize existing and emerging technologies.

CIT provides technology leadership in several key ways. First, CIT stimulates and supports the development and application of biotechnology, computer-aided engineering, information technology, materials, and other emerging technologies that could lead to significant industries in Virginia in the 21st century. Second, CIT establishes centers of excellence in technology areas that address critical industry needs. Third, CIT takes an active role in transferring technology by creating partnerships between corporations and Virginia universities to expedite the development and commercialization of technology.

CIT sponsors state-of-the-art research at Virginia's universities through its Research Institutes and Technology Development Centers for present and future industrial needs. It also transfers knowledge and/or resources available from Virginia's universities and community colleges to industry through Technology Transfer Directors, Entrepreneurial Centers, Incubators, and a special Engineering Clinic.

Since small firms are the source of the majority of new jobs, CIT has taken steps to foster the growth of small, technology-based firms in Virginia. CIT's Innovation Center program provides hands-on assistance to newly formed technology-based companies. It has also helped increase the competitiveness and growth of companies in all regions of Virginia through the productive use of technology.

The new CIT building, in Herndon opposite Dulles Airport, symbolizes Virginia's bold commitment to be a leading technology state, serves as a focal point for the state's technology initiatives, and provides a meeting place where state and national leaders and experts can meet to discuss pressing technology issues of the day.

CIT programs have significant impact as described below.

Current Impact: Through June 1989, more than 4100 entrepreneurs, small, and large businesses contacted CIT to discuss or request assistance. More than 450 research projects have been started, and more than one-fourth have been completed. CIT has expended $37.2 million in research awards from FY 1985-1989, and these awards have generated $55.7 million in industry support. A substantial increase in the industrial/CIT matching funds ratio has occurred since 1985. The ratio has risen from 0.53 in 1985 to 2.03 in 1989. Approximately $14 million of economic impact, during its first year of operation in 1988, can be attributed directly to the assistance given Virginia businesses through the Technology Transfer Program run in conjunction with ten Virginia community colleges.

Near-term Impact: CIT's ten university-based Technology Development Centers expand existing expertise, concentrate resources in emerging technologies of specific interest to industry, and provide product and process development assistance. The Engineering Clinic furnishes technical assistance to help firms incorporate new production technologies and develop new products. Six Entrepreneurship Centers offer outreach services to entrepreneurs and small businesses. Three Incubators provide a supportive environment for start-up businesses to develop innovative products until their growth requires expanded facilities.

Long-range Impact: CIT is taking the lead in working with industry, academia, and government to formulate Virginia's long-range technology agenda, and CIT is identifying and assembling the experts needed to accomplish it. Through its Research Institutes and Technology Development Centers, CIT supports research teams to work on critical technology needs of Virginia industry which must be met over the next two - five years. CIT is pursuing other opportunities with long-range impact to take advantage of Virginia's inherent strengths such as a highly educated work force, a growing electronics and communication industry, and the headquarters for the Space Station.

Interaction with Federal Laboratories: CIT has also begun to work with the federal laboratories to help them transfer technology to the private sector. In particular, a memorandum of understanding was signed on June 12, 1989 by the Commonwealth of Virginia and CIT with the NASA Langley Research Center and the NASA Goddard Space Flight Center. Programs have also been started with the U.S. Army Night Vision and Electro-Optics Laboratory at Fort Belvoir, VA for a cooperative effort to transfer the Laboratory's technology to private industry in Virginia. Discussions have also been initiated for transfer programs with the National Science Foundation; the Electronics Technology and Devices Laboratory, Fort Monmouth, New Jersey; the Harry Diamond Laboratory, Adelphi, MD; and the Army Research Office, Research Triangle Park, North Carolina. CIT also participates on the Advisory Board of the Middle Atlantic Region of the Federal Laboratory Consortium.

CIT's Programs: Other CIT programs and activities are described in the attachments: A - The CIT brochure; B - Building Virginia's Economic Base Through Technology Transfer; C -Virginia Focuses on Space; and D - Virginia's Center for Innovative Technology: Strategies and Programs.

II. The Pursuit of Federal Technologies by Virginia Firms.

In our estimation most Virginia firms are not actively pursuing available federal technologies for purposes of commercialization. The difficulties in obtaining technical information from the federal laboratories are quite significant:

(1) Most laboratories only have a part-time person or a very small staff at best to facilitate the technology transfer activities.
(2) It is very difficult to target particular scientific activities in a given laboratory. This is particularly difficult for small or medium sized firms who do not have people that they can dedicate to searching for technologies of interest on a full-time basis.
(3) Each federal laboratory does things differently in terms of how it markets and licenses its technology.

(4) Each agency maintains its own data base of what is happening in its laboratories, with its own protocol for querying the data base.
(5) Furthermore, much of the technology at the federal laboratories is mission oriented and not immediately suitable for commercial application without further development.
(6) Most federal scientists are fully involved with doing their budgeted, mission-oriented research and dealing with the time-consuming federal procurement system. They do not have the time or motivation to deal with many simultaneous queries from the business community to adapt the results of their research to several different commercial applications.
(7) The federal laboratories find themselves in a "Catch 22" situation: with a mandate from Congress to effect technology transfer but with little or no money from Congress to carry out that mission.

All of these constraints tend to discourage the small and medium sized businesses from trying to interact with the laboratories. CIT itself is just establishing a working knowledge of the resources available from the large number of federal laboratories and expects to play an active role in transferring their technology.

Our experience with the federal technology transfer programs leads us to emphasize several concerns. Namely, there seems to be a major lack of personnel available at the federal laboratories to support the programs. They are either part-time personnel or they are not sufficiently versed in the programs available to be of assistance in a reasonable time. Many of the small businesses need some reasonably quick response time for the information to be useful, since in many instances they are responding to a request, from the federal government itself or from other companies, that has a deadline for receipt of a proposal. The lack of understanding by laboratory representatives of the needs and time constraints that small businesses face represents a significant impediment. The methods for keeping track of requests for help within a laboratory are almost non-existent so that it is difficult to effectively manage a program.

These many problems impede technology transfer. They lead one to believe that much more help at the state and local level, in the form of technology extension personnel who can act as the intermediaries between businesses and laboratories, is required. We feel this is one of the most important mechanisms that can be put in place to dramatically affect the efficiency of the federal laboratory tech-transfer programs.

III. Recommendations for Improving the Federal Technology Transfer Process

For all of the above noted reasons U.S. industry is not capitalizing upon the technology available from the federal laboratories. Three things must happen before U.S. industry can take advantage of such technology. First, entities separate from the laboratories, either private or public, must be created to sift through the data available and identify useable technology. This may in some cases be achieved by quasi-public organizations such as CIT. Second, this identification process must be done in conjunction with competent end-users, who can take commercial advantage of the technology identified. A number of foreign countries and companies are very effectively sifting through our available technology in this manner. Finally, the federal laboratory technology program needs a major marketing effort that reaches down to the grass-roots small and medium-sized businesses, whose success can have an important impact on our competitive position. This effort can be supplied, to a large degree, by many of the state programs which are now in place. An example is the CIT technology transfer program, which provides extension services to Virginia's small and medium sized businesses. We strongly urge that federal monies be made available to augment these state programs so that they can concentrate on reviewing the federal technologies available and on transferring them to suitable companies for commercialization.

Accelerating technology transfer from the federal laboratories alone will not solve America's competitiveness problem. The federal government must engage in other policy changes to effectively allow U.S. industry to once again become competitive. This federal effort should include serious consideration of:

(1) a reduction in the U.S. budget deficit;
(2) a change of federal policy to support savings and investment by reducing permanently capital gains taxes, eliminating double taxation on dividends, reducing taxation on interest accrued from savings, and reducing tax benefits for interest payments on all debts but home ownership;
(3) clarification and modification of the U.S. antitrust laws to take into consideration the new worldwide competitive environment which U.S. companies are facing;
(4) promote additional collaborative R&D programs by providing federal incentives such as financial support, positive tax treatment for R&D efforts and the establishment of procedures to allow for review and acceptance of industrial combinations by the Justice Department which otherwise might be illegal.
(5) promotion of education and reeducation for technology support personnel to provide a skilled labor force

necessary for the development of high technology industry;

(6) promotion of science and engineering education in the high school and university systems to provide the technical leadership for high technology industry.

Finally, it should be recognized that standards of quality should be promulgated from the top down throughout the federal and U.S. management systems. It is this emphasis on quality control in every aspect of life from the training of people to the final products and services delivered to customers that was emphasized by W. Edwards Deming in his efforts to revitalize the Japanese industrial system after World War II. Since then the Japanese have been successful in world competition primarily because of their adherence to the principles of quality control that he taught. It is time that we in the U.S. should also pay attention to these teachings.